CABIN PRESSURE REGULATOR AND OUTFLOW VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Cabin Pressure Regulator and Outflow Valve (see Figure 201)

A. General.

(1) Access to the forward pressure regulating outflow valve is obtained through the electrical and electronics compartment door.

(2) Access to the aft pressure regulating valve is obtained through the zippered lining at the aft bulkhead of the aft cargo compartment.

B. Remove Cabin Pressure Regulator and Outflow Valve.

(1) Open FWD and AFT CABIN PRESSURE REGULATOR circuit breakers.

(2) At forward outflow valve, disconnect pneumatic tubing from fitting on valve body; loosen opposite ends of tubing at valve mounting base to permit rotation of tubing. This will facilitate valve removal without bending the tubing. (Cap open ends of tubing and fittings.)

(3) At aft outflow valve, disconnect airplane tubing from tee fittings on valve body.

(4) Remove screws and clips securing wiring harness to outflow valve.

(5) Disconnect two wires from terminal strip on side of outflow valve. (Tag for installation.)

(6) Disconnect electrical connector from receptacle on top of valve. (Cap and tag for installation.)

(7) Disconnect Marman clamp from base of valve.

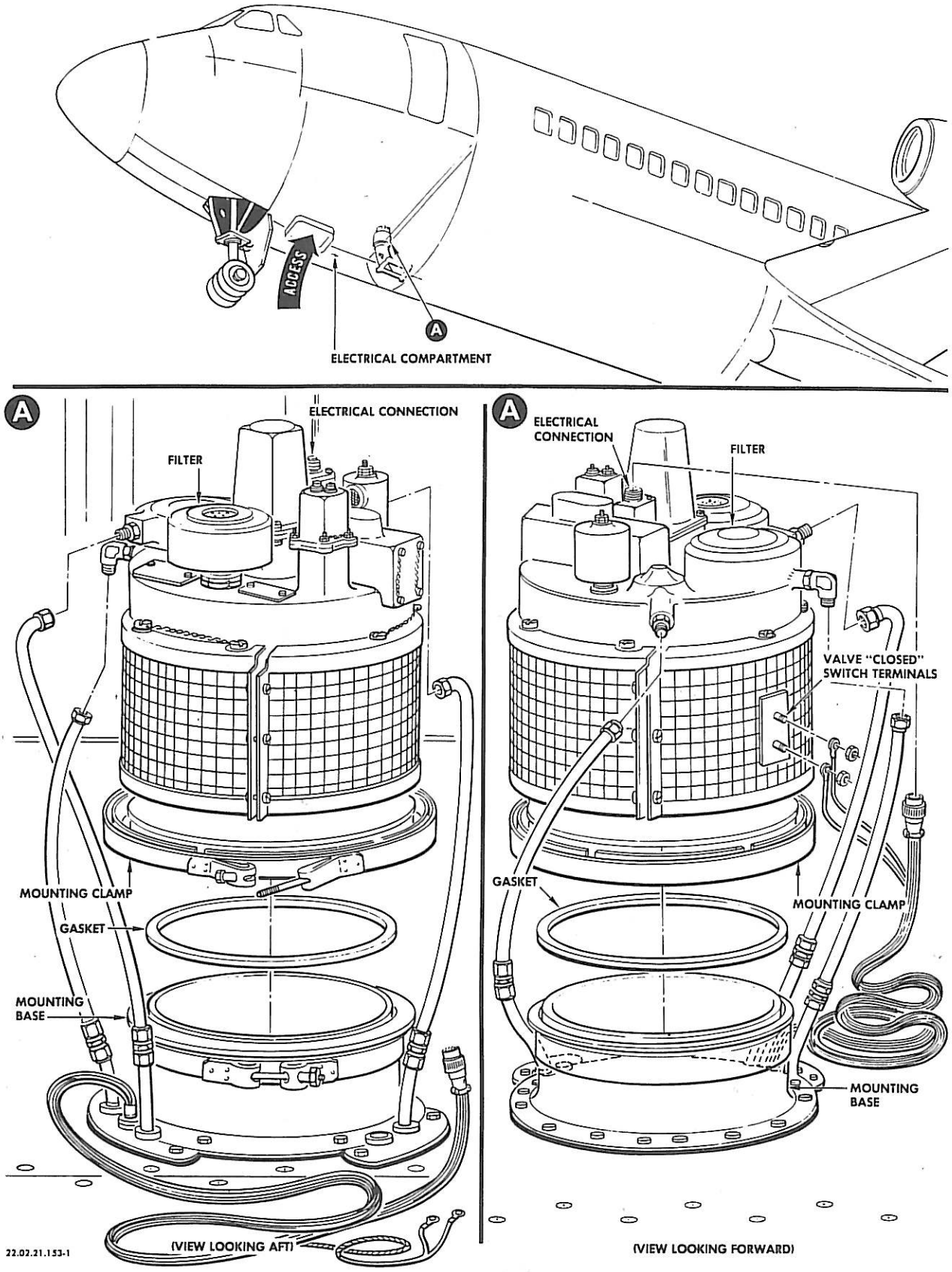
(8) Remove pressure regulating outflow valve and gasket.

NOTE: At aft outflow valve, note position of short pieces of tubing and tee fittings. Remove tee fittings from valve (with tubing attached) and hold for installation on replacement valve.

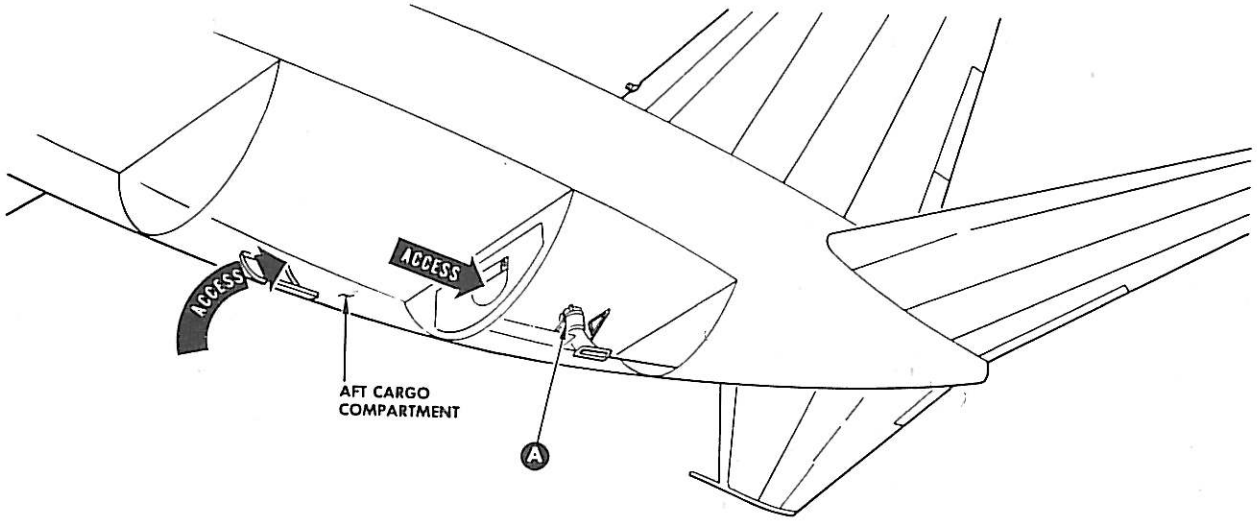
C. Install Cabin Pressure Regulator and Outflow Valve.

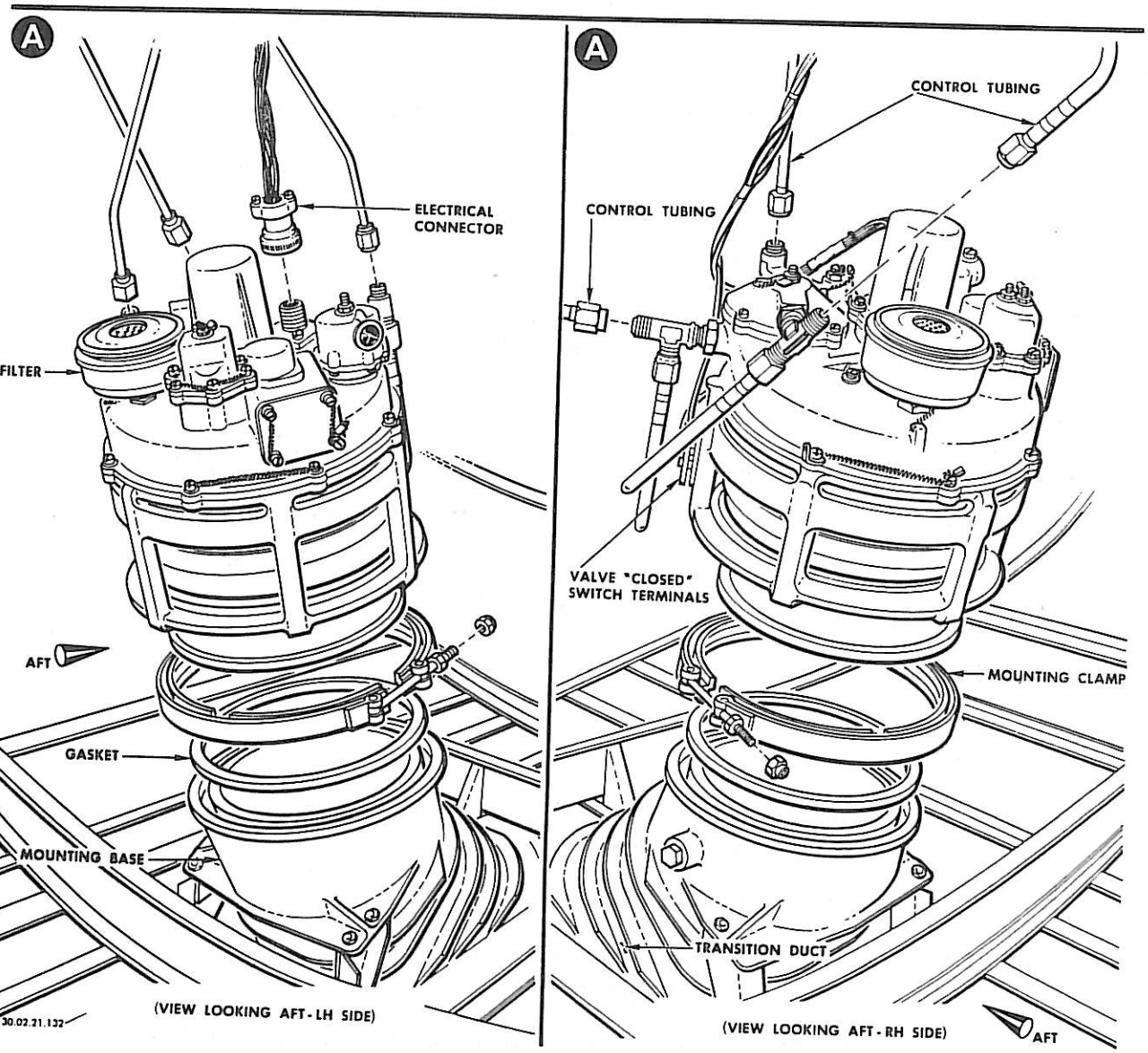
(1) Position valve on its base with Modification Record Tag forward along centerline of airplane. Ascertain that gasket is placed between valve and mounting base.

CAUTION: WHEN INSTALLING FORWARD OUTFLOW VALVE MAKE SURE THAT VALVE HAS EXTERNAL PROTECTIVE SCREEN.



Pressure Regulator and Outflow Valve Installation
Figure 201 (Sheet 1 of 2)





Pressure Regulator and Outflow Valve Installation
Figure 201 (Sheet 2 of 2)

(2) Position Marman clamp around base of valve; tighten clamp.

(3) Connect electrical connector to receptacle on top of valve.

(4) Connect two wires to terminal strip on side of outflow valve.

(5) Install clips and screws to secure wiring harness to outflow valve.

(6) At forward outflow valve position and connect pneumatic tubing to fittings on valve; tighten tubing connections at outflow valve and at opposite ends of tubing at valve mounting base.

NOTE: It should not be necessary to bend any of the tubing. If connections do not line up, it is permissible to rotate the valve a few degrees on its base.

(7) At aft outflow valve install and position tee fittings, with short pieces of tubing, on outflow valve; connect airplane tubing to tee fittings and tighten all connections.

(8) Close FWD and AFT CABIN PRESSURE REGULATOR circuit breakers.

(9) Perform leak test of static system sensing lines (refer to Chapter 34, NAVIGATION).

(10) Perform Adjustment/Test procedure (refer to 21-2-0, PRESSURIZATION CONTROLS AND INDICATION).

2. Removal/Installation Pressure Regulator and Outflow Valve Cabin Air Filter

A. Equipment Required - None.

B. Remove Pressure Regulator and Outflow Valve Cabin Air Filter.

(1) Open FWD or AFT CABIN PRESSURE REGULATOR circuit breakers as required.

(2) Loosen lower jam nut at base of filter housing.

(3) Unscrew filter housing from top of pressure regulator.

(4) Cover port in pressure regulator to prevent entry of foreign matter.

(5) Replace filter element and clean filter housing and orifice (refer to Chapter 12, SERVICING).

C. Install Pressure Regulator and Outflow Valve Cabin Air Filter.

(1) Screw filter housing into top of pressure regulator; tighten jam nut at base of filter housing.

(2) Close FWD or AFT CABIN PRESSURE REGULATOR circuit breakers.

AIR CONDITIONING SUBSYSTEM - DESCRIPTION AND OPERATION

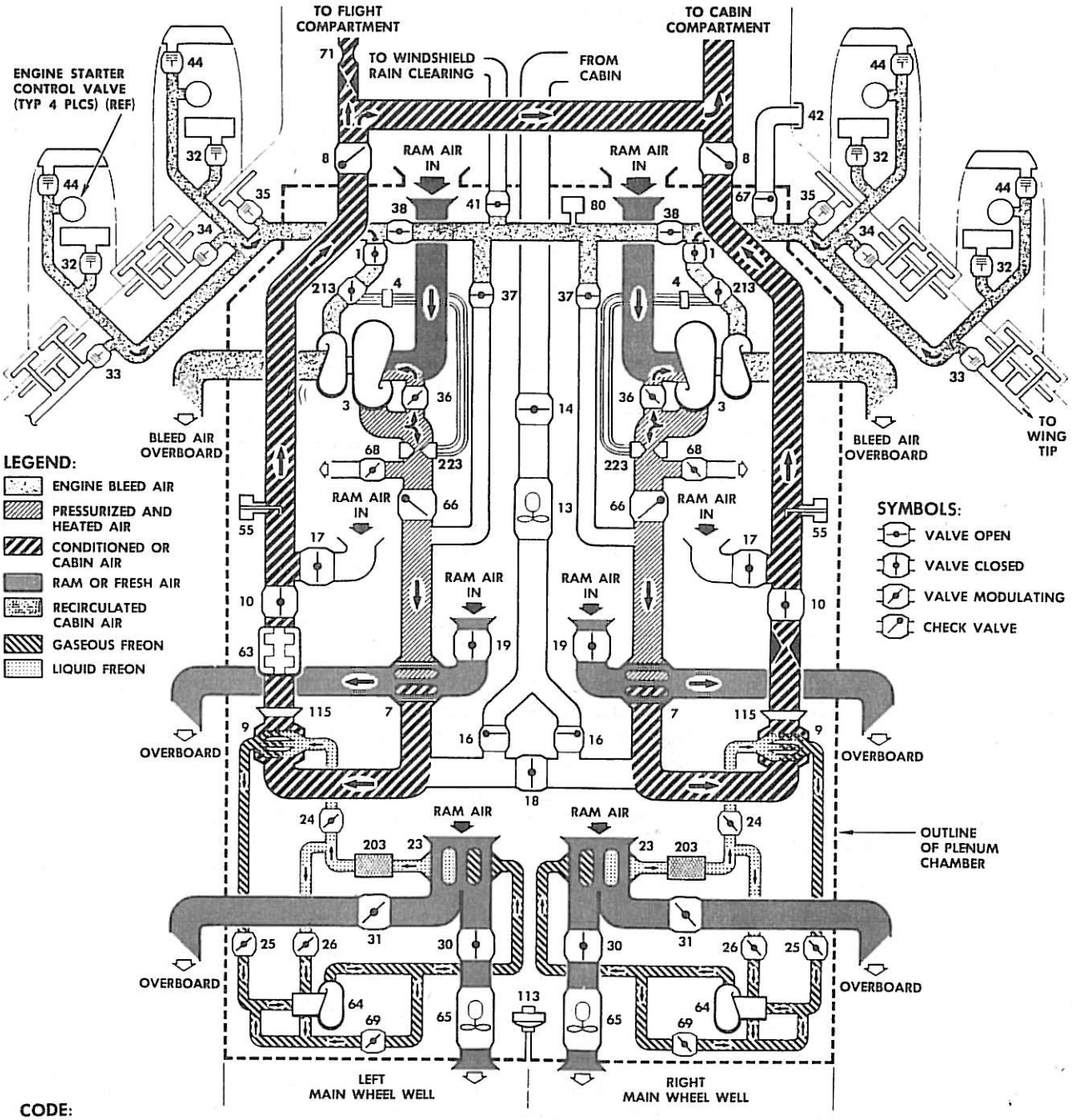
1. General

The air conditioning subsystem consists of two independent parallel air conditioning units and is shown schematically on Figure 1. The parallel air conditioning units are connected by crossover ducting and a cabin air recirculation subsystem. The units are identical except for minor connections which will be noted.

The pressurized air as it leaves the turbocompressor must be heated or cooled as required to provide properly conditioned air for maximum passenger and crew comfort. These demands of heated or cooled air are governed by the temperature control and temperature equalization subsystems. Heating of the pressurized air (described in detail in 21-1-0, PRESSURIZATION SUBSYSTEM) is accomplished automatically when the ram air is compressed. The pressurized air can also be heated to a higher temperature by recirculating the compressed air through the compressor. Cooling the air is accomplished, when the airplane is in flight, by the use of an air-to-air heat exchanger backed up by a Freon refrigeration subsystem. The compressed air is ducted from the turbocompressor to an air-to-air heat exchanger for the first stage of cooling. The air after passing through the first stage of cooling is then ducted to the second stage of cooling which utilizes a Freon refrigeration subsystem. Second stage cooling is used only if the first stage is incapable of cooling the air sufficiently to meet the demands of the temperature control subsystem. When the airplane is on the ground no ram air is available for cooling at the air-to-air heat exchanger so it is incapable of meeting any cooling demands. When the air-to-air heat exchanger is incapable of sufficient cooling the Freon refrigeration subsystem is activated and provides cooling of the pressurized air. The heated and/or cooled pressurized air is then ducted to the air distribution subsystem for distribution to the cabin and flight compartments. For a more detailed description and operation of the distribution subsystem, refer to 21-9-0, AIR DISTRIBUTION SUBSYSTEM.

2. Primary Cooling

Pressurized and heated air is ducted from the turbocompressor to the air-to-air heat exchanger. As the air flows to the heat exchanger, it passes through a venturi duct and a check valve. The check valve prevents reverse airflow through the turbocompressor if the turbocompressor is not operating and air conditioning and pressurization is being provided by the other turbocompressor or the emergency pressurization subsystem. The air-to-air heat exchanger contains an exchanger core of the plate and fin design. The core provides for one straight through pass for cooling ram air and two passes in a cross-counter flow for pressurized air. The ram air cools the exterior surface of the core to extract heat from the pressurized air flowing through the inside of the core. The amount of cooling of the pressurized air is regulated by the heat exchanger cooling air modulating valve. The amount of cooling ram air allowed to pass through the heat exchanger by the modulating valve is controlled by the temperature control subsystem.



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4. TURBOCOMPRESSOR FLOW CONTROL
7. HEAT EXCHANGER
8. CONDITIONED AIR CHECK VALVE
9. FREON EVAPORATOR
10. CONDITIONED AIR EMERGENCY SHUTOFF VALVE
13. RECIRCULATION FAN
14. RECIRCULATION CONTROL VALVE
16. RECIRCULATION AIR CHECK VALVE
17. RAM AIR SHUTOFF VALVE
18. CROSSOVER SHUTOFF VALVE
19. HEAT EXCHANGER COOLING AIR MODULATING VALVE
23. FREON CONDENSER
24. FREON EXPANSION VALVE
25. BACK PRESSURE REGULATOR VALVE
26. MOTOR COOLING EXPANSION VALVE
30. CONDENSER GROUND COOLING AIR SHUTOFF VALVE
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32. ENGINE BLEED AIR VALVE
33. OUTBOARD LEADING EDGE ANTI-ICING VALVE
34. MIDSECTION LEADING EDGE ANTI-ICING VALVE
35. INBOARD LEADING EDGE ANTI-ICING VALVE
36. HEAT CONTROL MODULATING VALVE
37. EMERGENCY CABIN AIR FLOW VALVE
38. BLEED AIR EMERGENCY WING ISOLATION VALVE
41. WINDSHIELD RAIN REMOVAL VALVE
42. ENGINE START AIR CONNECTION
44. ENGINE INLET DUCT LIP ANTI-ICING VALVE
55. AIR FLOW SENSOR AND TRANSMITTER
63. ELECTRIC HEATER—FLIGHT DECK
64. FREON COMPRESSOR
65. CONDENSER FAN
66. TURBOCOMPRESSOR CHECK VALVE
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68. TURBOCOMPRESSOR SURGE VALVE
69. FREON COMPRESSOR SURGE VALVE
71. FLIGHT COMPARTMENT AIRFLOW LIMITER
80. BLEED AIR OVERPRESSURE SWITCH
113. PLENUM CHAMBER PRESSURE SWITCH
115. WATER SEPARATOR
203. FREON DRIER AND STRAINER
213. NOZZLE ACTUATOR
223. VENTURI DUCT

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Air Conditioning Schematic
Figure 1

The conditioned air from the heat exchanger is ducted to the Freon evaporator where it will receive further cooling, when necessary, and dehumidification if cooling is called for. The conditioned air is then distributed to the passenger and crew compartments.

3. Freon Refrigeration Subsystem

The secondary cooling stage utilizes a Freon refrigeration subsystem. This is a closed vapor-cycle refrigeration system, utilizing Freon 114 as the coolant, and consisting of a Freon compressor, condenser, evaporator, interconnecting tubing, and control devices.

4. Air Conditioning Operation

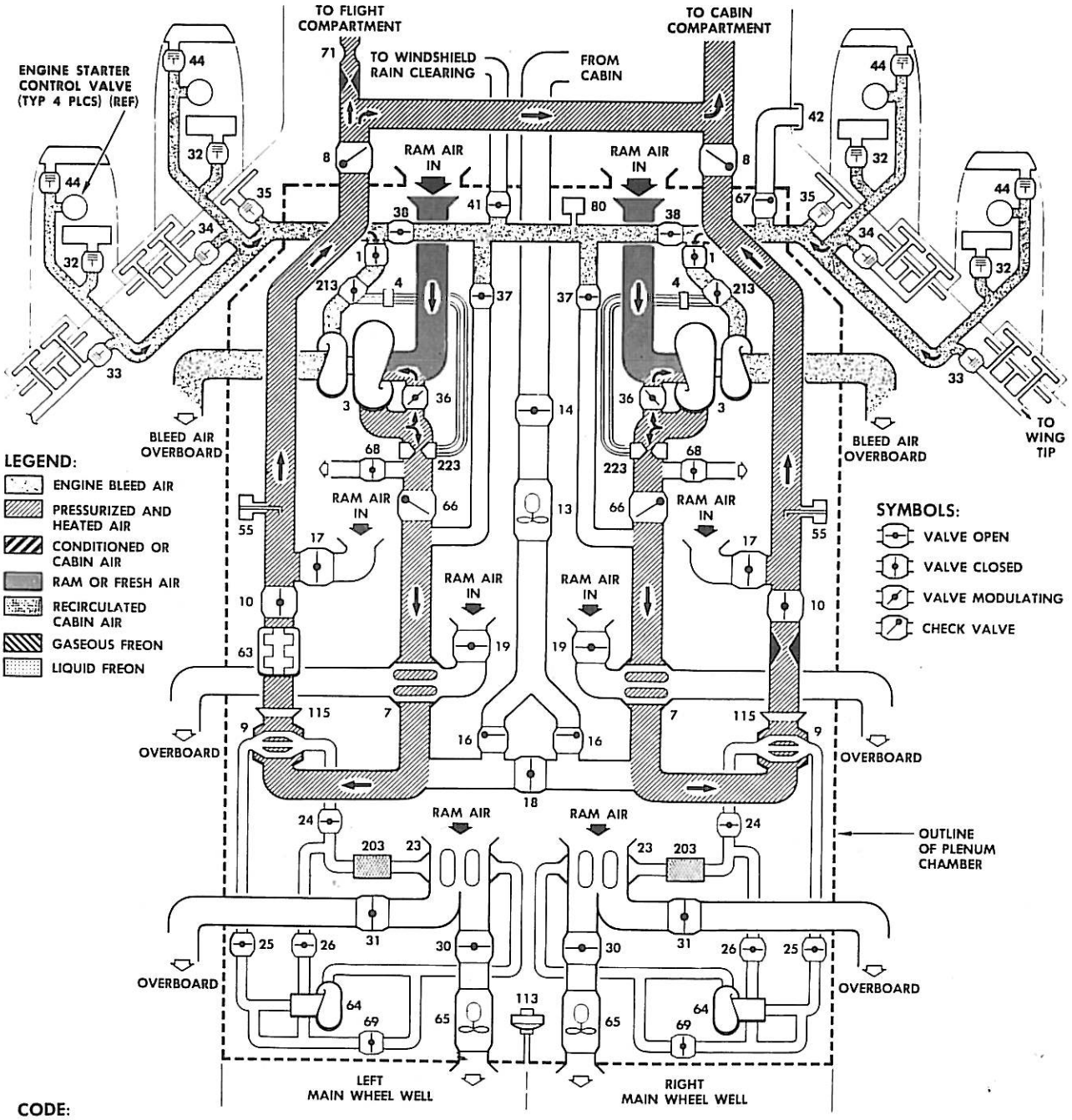
The air conditioning subsystem provides for control of three environmental factors in the airplane; cabin and flight compartment temperatures, replenishing of cabin and flight compartment air, and removal of moisture from the refrigerated air. The air conditioning subsystem is capable of cooling the compressed air, heating the recirculating cabin air, removing moisture and controlling subsystem operation. Conditioned air heating is accomplished by two different methods; (1) recirculating pressurized air through the turbocompressor (covered under pressurization subsystem) and (2) electric heating. Air cooling is accomplished by two cooling subsystems; (1) an air-to-air heat exchanger and (2) a Freon refrigeration cooling subsystem. Recirculation of cabin air is accomplished by using an electric driven fan, ducting, and associated valves. Moisture removal is accomplished as a part of the Freon refrigeration subsystem operation. Control of system operation is accomplished by the temperature control subsystem and is covered in 21-4-0, AIR CONDITIONING CONTROL AND INDICATION.

As illustrated in Figure 1, ram air is compressed and heated in the turbocompressor. It is then cooled, if necessary, while flowing through the air-to-air heat exchanger and the Freon evaporator. It is then distributed to the flight and cabin compartments. There are five normal modes of heating or cooling the flight and cabin compartments while the airplane is in flight or on the ground. These modes of operation are described in the following paragraphs.

A. Inflight Heating.

During flight, the recirculation control valve and the flight deck electric heater are not subject to control by the temperature control system, thus, the valve is closed and the electric heater is off.

As shown in Figure 2, the turbocompressor shutoff valve is open allowing engine bleed air to operate the turbocompressor. Ram air from the plenum chamber enters the compressor side of the turbocompressor where



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66. TURBOCOMPRESSOR CHECK VALVE
67. ENGINE START CHECK VALVE
68. TURBOCOMPRESSOR SURGE VALVE
69. FREON COMPRESSOR SURGE VALVE
71. FLIGHT COMPARTMENT AIRFLOW LIMITER
80. BLEED AIR OVERPRESSURE SWITCH
113. PLENUM CHAMBER PRESSURE SWITCH
115. WATER SEPARATOR
203. FREON DRIER AND STRAINER
213. NOZZLE ACTUATOR
223. VENTURI DUCT

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Air Conditioning Schematic - Inflight Heating
Figure 2

it is compressed and heated. If one pass through the compressor does not heat the air enough as called for by the temperature control system, a portion of the air is recirculated through the compressor by the heat control modulating valve.

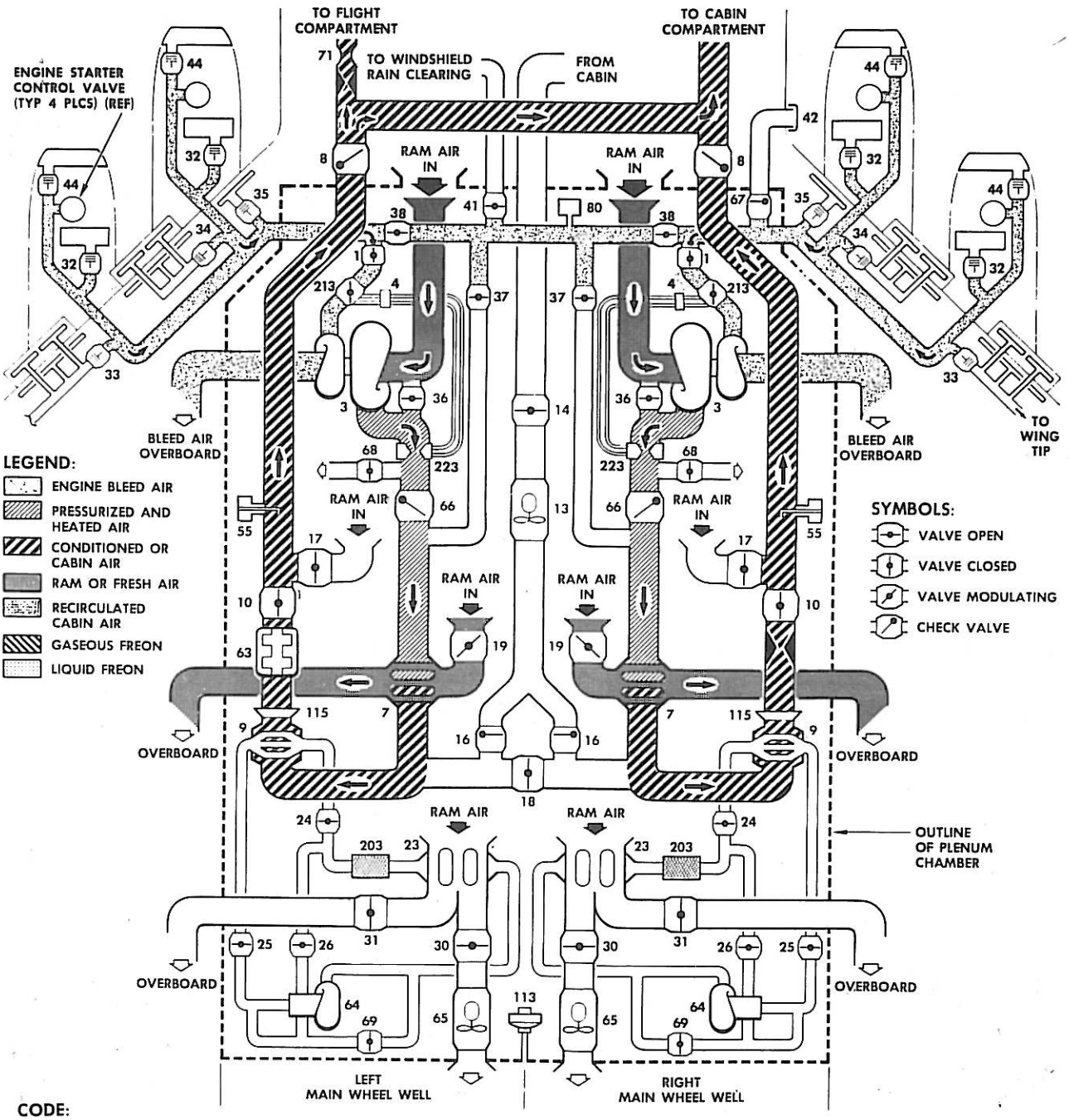
The heated and compressed air then flows through the turbocompressor venturi duct and check valve to the heat exchanger.

The compressed and heated air flows through the heat exchanger without any cooling. When the heat exchanger cooling air modulating valve is closed ram air cannot flow through the heat exchanger for cooling purposes. The conditioned air flows from the heat exchanger and into the Freon evaporator. As the temperature control system is calling for maximum heat, the Freon refrigeration subsystem is inoperative. The conditioned air flows through the Freon evaporator without any cooling and into the flight deck and cabin electric heaters. Airflow through the flight deck electric heater receives no additional heating, because the heater is inoperative in flight. The heaters in the cabin ducts heat the air as required to maintain a 2 degree F (1.1 degree C) maximum temperature differential between the fore and aft cabin areas. The conditioned air flows from the heaters, passes through the conditioned air emergency shutoff valves and check valves and is routed by the air distribution subsystem to the cabin and flight compartments.

B. Inflight Intermediate.

During the inflight intermediate range, the temperature control system is not calling for additional heating. As shown in Figure 3, the heat control modulating valve is closed, indicating that the air is being heated enough with one pass through the compressor. The compressed air flows from the turbocompressor to the air-to-air heat exchanger.

The heat exchanger cooling air modulating valve is in the modulating position, indicating that the temperature control system is calling for slightly cooler air than is coming from the turbocompressor. The heat exchanger cooling air modulating valve allows ram air to flow through the heat exchanger. The ram air cools the heated air to obtain the air temperature called for by the temperature control system. The conditioned air flows from the heat exchanger to the Freon evaporator. The air receives no cooling in the Freon evaporator because sufficient cooling is being accomplished in the heat exchanger. The conditioned air flows through the electric heaters (flight deck heater inoperative during flight) and is routed by the air distribution subsystem to the cabin and flight compartments. The conditioned air delivered to the cabin is heated, if necessary, by the cabin dual heaters. Cabin heater operation is determined by the temperature equalization control system to maintain the air temperature between the forward and aft cabin areas within a maximum differential of 2 degrees F (1.1 degree C).



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223. VENTURI DUCT

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Air Conditioning Schematic - Inflight Intermediate
Figure 3

C. Inflight Cooling.

When the temperature control system is calling for cooling, the heat control modulating valve is closed. Ram air is compressed in the turbocompressor and heated somewhat due to compression. The compressed air flows from the turbocompressor to the heat exchanger where the air receives initial cooling. As shown in Figure 4, the heat exchanger cooling air modulating valve is open, in this case full-open, because the temperature control system is calling for more cooling than the heat exchanger can provide.

Since the heat exchanger is operating at capacity and the temperature control system is calling for more cooling, the Freon refrigeration system is actuated.

When the Freon refrigeration system is actuated, Freon in the evaporator extracts heat from the air flowing through the evaporator. The degree of cooling which the air receives in the evaporator is automatically controlled by the temperature control system and Freon package.

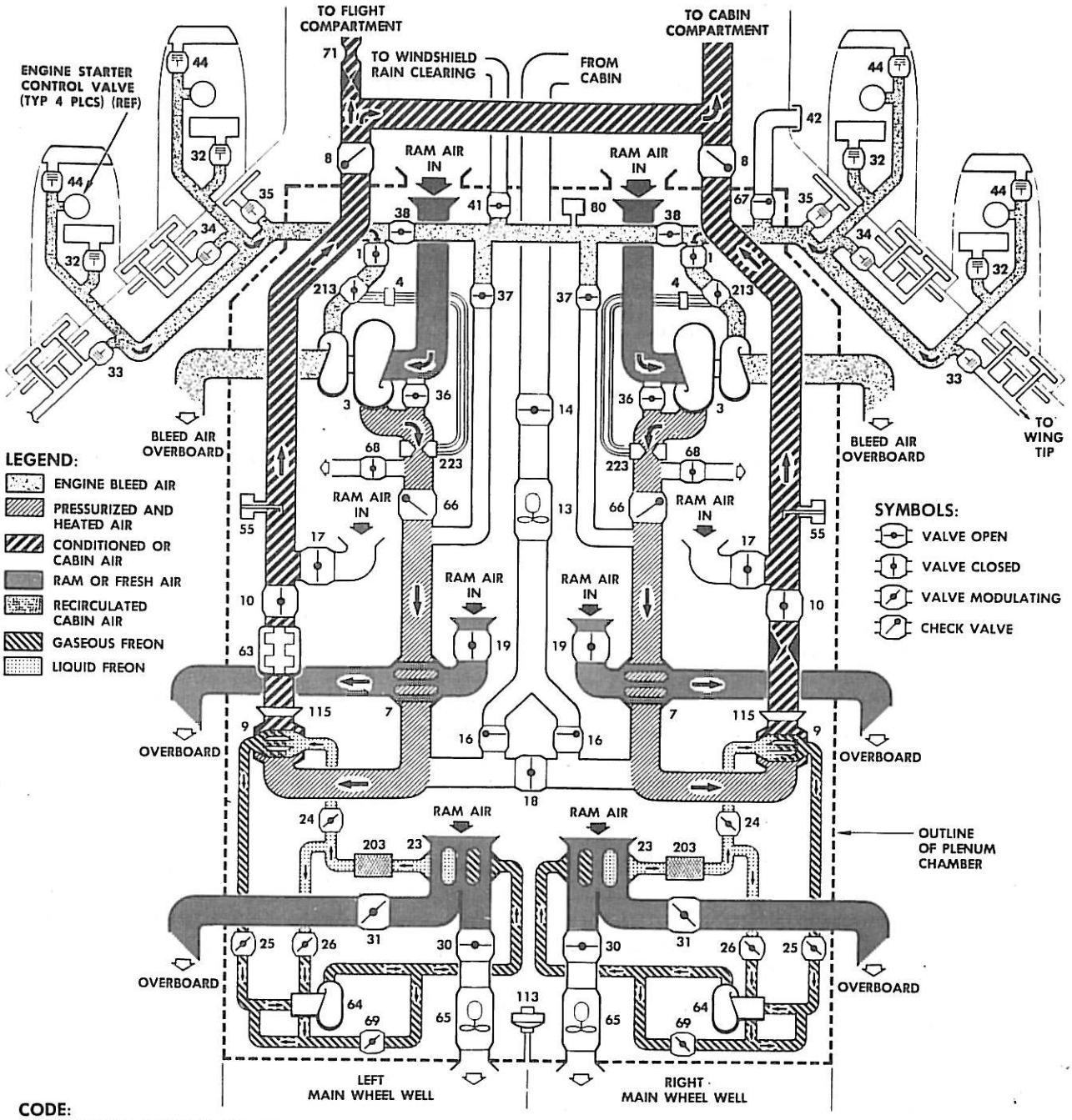
D. Ground Heating.

When the airplane is groundborne with the engines shut down, no bleed air is available to operate the turbocompressors (see Figure 5). When the turbocompressors are inoperative the recirculation fan provides the necessary airflow to condition the cabin and flight deck. Cabin air, which is discharged into the forward cargo compartment, is picked up at the aft end of the compartment through the recirculation control valve. The cabin air is then recirculated through the air conditioning system to the air distribution system.

When heating is scheduled the Freon refrigeration system is shut down and all Freon system valves are closed. The recirculated air is heated by the flight deck and cabin heaters. Heater operation is controlled by the temperature control and temperature equalization systems. When the air temperature stabilizes at the selected or desired temperature, the temperature equalization system functions to maintain a constant temperature between the forward and aft cabin compartments.

E. Ground Cooling.

With the airplane on the ground, the engines shut down, and the temperature control system calling for cool air, the system works as follows: As shown in Figure 6, the turbocompressors are inoperative, the recirculation fan is on, and the recirculation control valve is open. Cabin air is moved by the recirculation fan to the Freon evaporator, where it is cooled to the temperature scheduled by the temperature control system. As the temperature control system is scheduling cooler air, the electric heaters are inoperative and the cool air flows through the air distribution system to the cabin and flight compartments.



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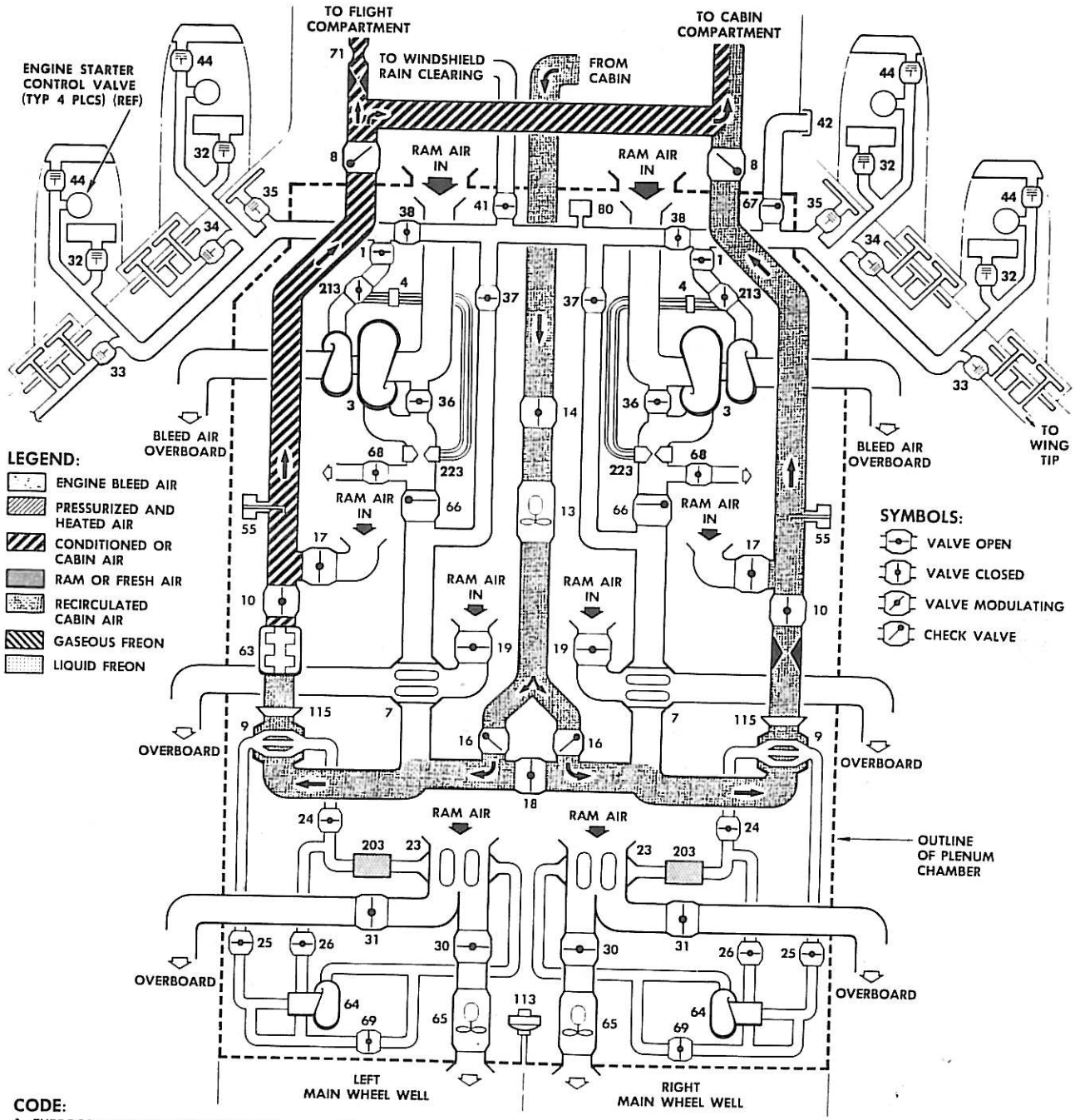
Air Conditioning Schematic - Inflight Cooling
Figure 4



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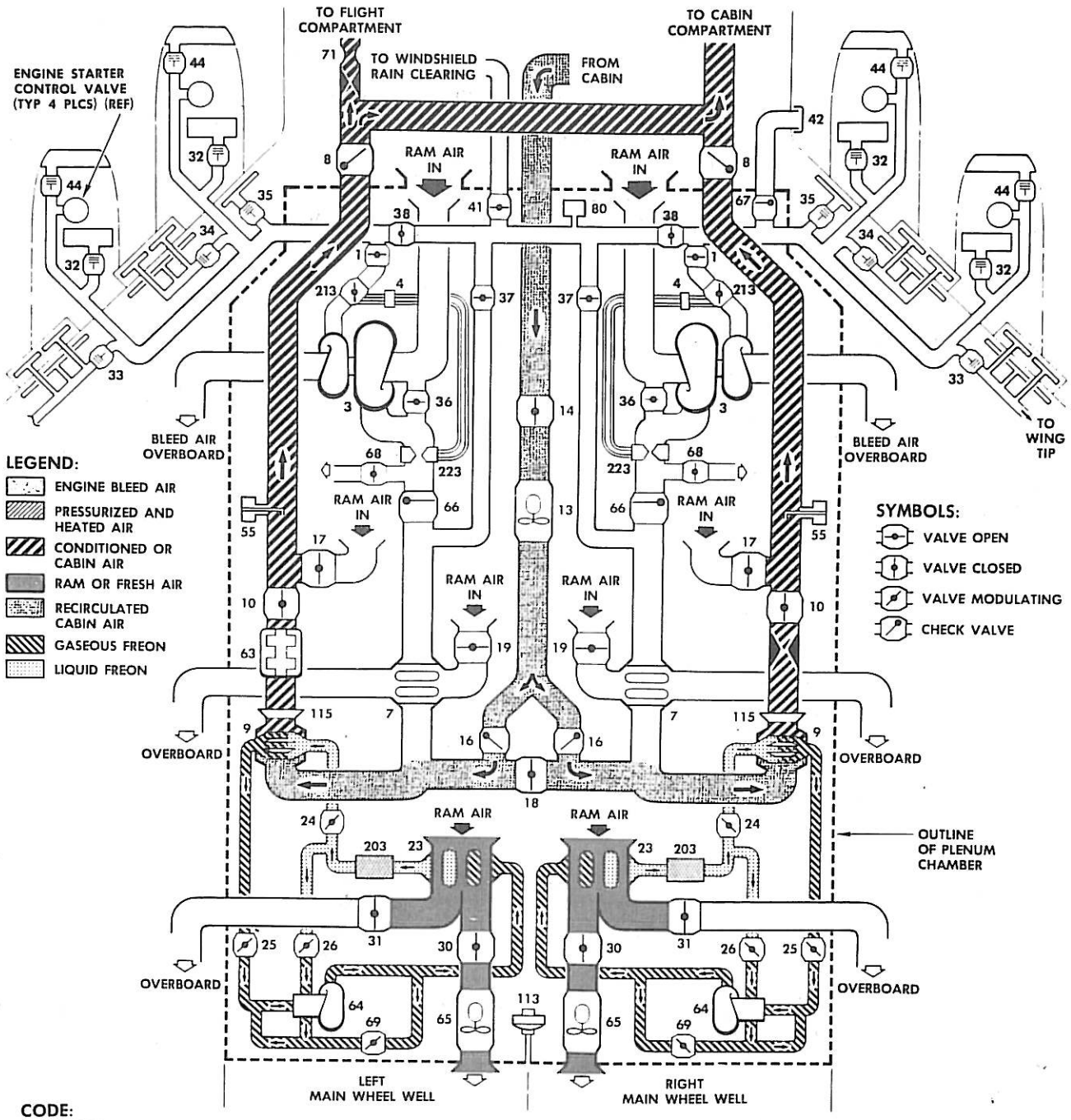

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67. ENGINE START CHECK VALVE
68. TURBOCOMPRESSOR SURGE VALVE
69. FREON COMPRESSOR SURGE VALVE
71. FLIGHT COMPARTMENT AIRFLOW LIMITER
80. BLEED AIR OVERPRESSURE SWITCH
113. PLENUM CHAMBER PRESSURE SWITCH
115. WATER SEPARATOR
203. FREON DRIER AND STRAINER
213. NOZZLE ACTUATOR
223. VENTURI DUCT

30.02.21.128

Air Conditioning Schematic - Ground Cooling
Figure 6

AIR CONDITIONING SUBSYSTEM - TROUBLE SHOOTING

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
1. LOSS OF TEMPERATURE CONTROL IN AUTOMATIC OPERATION (MANUAL TEMPERATURE CONTROL OK)	
A. Malfunctioning temperature control (cabin or flight compartment).	Operate cabin and flight compartment systems one at a time to identify which does not deliver heated or cooled air as scheduled. Interchange temperature controls between cabin and flight compartment systems. If faulty system then operates properly, replace malfunctioning temperature control.
B. Malfunctioning temperature selector or thermal resistor.	Replace temperature selector on clean flight engineer's panel. If no result, check that thermal resistors are clean and their pickup ducts are clear of obstructions. If clean, replace supply duct temperature pickup thermal resistor. If no result, replace discharge duct temperature pickup thermal resistor.
2. LOSS OF TEMPERATURE CONTROL IN MANUAL OPERATION (AUTOMATIC OPERATION OK)	
A. Malfunctioning switch, wiring or temperature control.	Check operation of AUTO-OFF-MAN switch, MAN HOT-MAN COLD switch, 160 degree F limit switch, and associated wiring to temperature control. Operate cabin and flight compartment systems one at a time to identify which does not deliver heated or cooled air as scheduled. Interchange temperature controls between cabin and flight compartment systems. If faulty system then operates properly, replace malfunctioning temperature control. CAUTION: DO NOT USE AN OHMMETER FOR CHECKING WIRES CONNECTED TO THE TEMPERATURE CONTROL.

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
3. LOSS OF TEMPERATURE CONTROL IN BOTH AUTOMATIC AND MANUAL OPERATION	
A. Malfunctioning temperature control	Refer to trouble 1A.
B. Malfunctioning sequencing device.	Operate air conditioning system and manually schedule full heating. Flight deck electric heater shall operate and Freon packages shall be shut down. Manually schedule full cooling; Freon packages shall operate and electric heater shall shut down. If above conditions do not exist, replace sequencing device.
4. INADEQUATE COOLING (FREON FAIL WARNING LIGHT NOT ILLUMINATED)	
A. Loss of Freon.	Check Freon liquid level gage for proper quantity.
B. Malfunctioning heat exchanger cool air modulating valve.	Simulate airborne conditions and manually schedule full cooling. Heat exchanger cool air modulating valve shall be fully open. If not open, check operation of valve.
C. Supply duct thermal resistors dirty or pickup ducts clogged.	Check that thermal resistors are clean. Remove any lint or debris from area surrounding pickup ducts.
5. INADEQUATE HEATING (AIRBORNE OPERATION ONLY)	
A. Malfunctioning heat exchanger cool air modulating valve.	Simulate airborne operation and manually schedule full heating. Heat exchanger cool air modulating valve shall be fully closed. If not closed, check operation of valve.
B. Malfunctioning heat control modulating valve.	Simulate airborne operation of turbocompressor and manually schedule full heating. Electric actuator on heat control modulating valve shall be open. If actuator indicates open position, feel at a conditioned air outlet for heated air. If heating is still inadequate, check operation of pneumatic actuator on heat control modulating valve, the heat recirculation temperature limiter control, and the connecting tubing.

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
5. INADEQUATE HEATING (AIRBORNE OPERATION ONLY) (CONT)	
	If heat control modulating valve electric actuator is closed in the preceding check, shut down system. Place AUTO-OFF-MAN temperature control switch in OFF position. Disconnect electrical connector from valve acutator and temporarily connect it to a replacement actuator held under the turbocompressor package. Operate system as outlined above. If replacement actuator moves to open position, replace heat control modulating valve.
6. INADEQUATE HEATING (GROUND OPERATION ONLY)	
A. Malfunctioning electric heater or heater controls.	Operate air conditioning system and recirculation fan. Manually schedule full heating. The electric heater shall deliver heated air. If heating is inadequate, check operation of recirculation fan control relay and ground safety relays. (Both must be energized to operate heater control relays.) Check circuit breakers and heater control relays in Freon package compartment. Check 115/200-volt ac wiring to heater terminals.
7. INADEQUATE COOLING OR HEATING ACCOMPANIED BY A WARNING LIGHT	
A. Inadequate cooling with Freon Fail warning light illuminated.	Refer to 21-3-1, FREON REFRIGERATION ASSEMBLY (FREON PACKAGE).
B. Inadequate heating with Overspeed Trip light illuminated.	Refer to 21-0, Trouble Shooting.

FREON PACKAGE AND AIR CONTROL COMPONENTS - DESCRIPTION AND OPERATION

1. General

The Freon package is a closed vapor cycle refrigeration system consisting of a compressor, condenser, evaporator, interconnecting tubing, and control devices. See Figure 1 for a schematic of the Freon package. The package operates on the principle that evaporation is a cooling process. Freon 114 gas is compressed and condensed into a liquid, and then evaporated to provide cooling of cabin air. Since the cooling also causes moisture to condense in the evaporator, the system provides humidity control by removing moisture from the cabin air.

The cabin and flight deck Freon packages are connected by a system of ducts and shutoff valves. An air recirculation subsystem is also connected to the cabin and flight deck packages by common ducting.

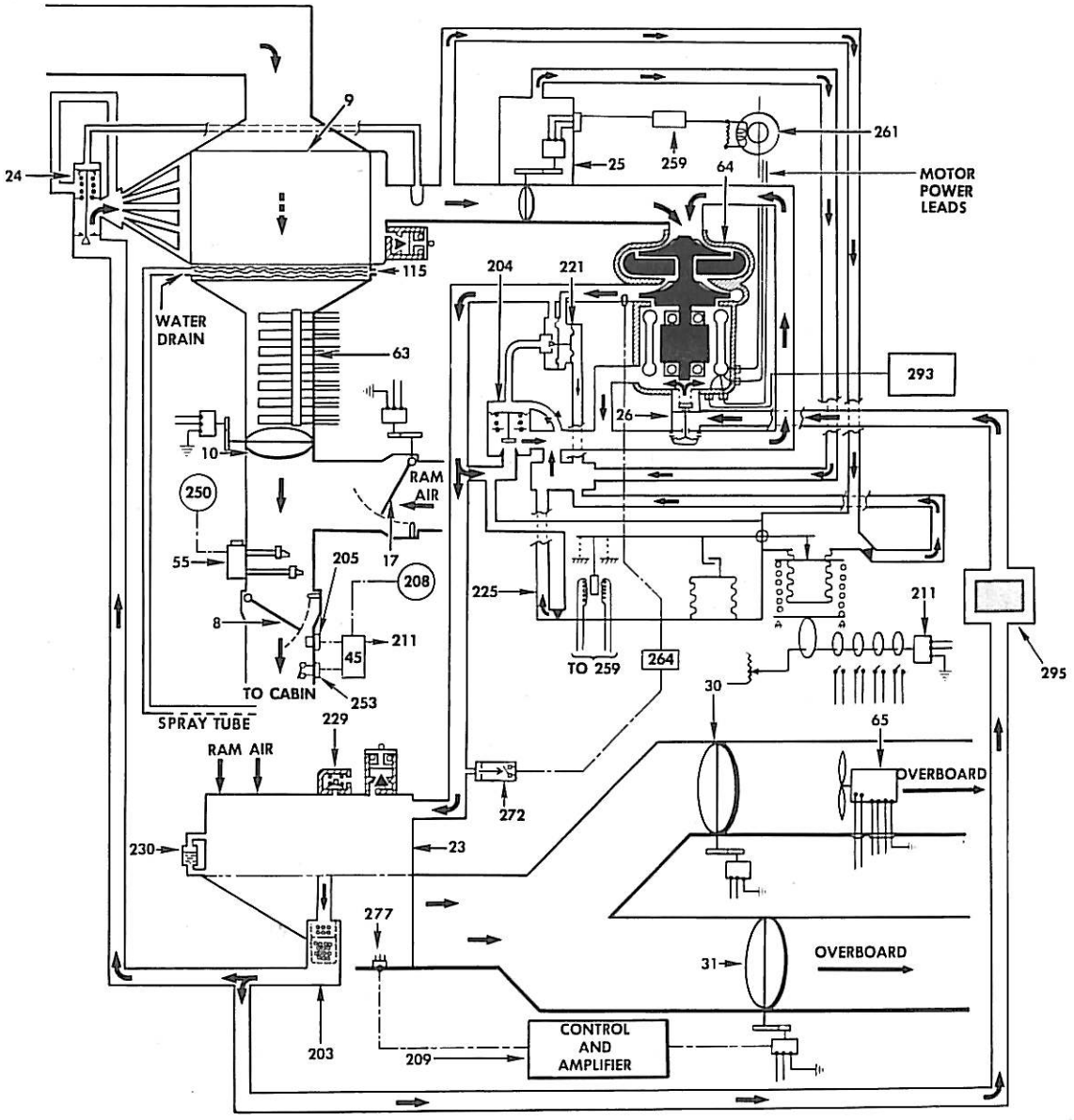
2. Freon Compressor

A. Description.

The Freon compressor is a two-stage, centrifugal-type compressor driven by an electric motor. As shown in Figure 2, the compressor impellers and the electric motor are mechanically linked by a common drive shaft. The impellers have swept-back blades which permit a wide stable operating range for various compressor flows at a nearly constant compressor speed. The electric motor is a "Y" connected induction motor operating from a 115/200-volt, three-phase, ac power source. The compressor is mounted on a support loop on the aft frame of the Freon package.

B. Operation.

The Freon compressor compresses Freon gas within the Freon package. Freon 114 is drawn into the compressor as a low pressure gas and as the gas is compressed its temperature rises as its pressure increases. The Freon is expelled from the compressor as a high pressure, high temperature gas. A hermetically sealed housing encloses the motor and compressor to provide maximum assurance against the loss of Freon or admission or air into the system. Control of electrical power to the compressor motor is provided by an external motor-power relay. The sequencing device directs 28-volt dc power to energize the motor power relay whenever Freon compressor operation is scheduled. To protect the compressor from damage due to motor overheat, Freon discharge overheat or Freon overpressure, the motor power relay is operated in conjunction with the lockout relay. An additional circuit protects the compressor motor from burning out should one current limiter in the 115/200-volt ac three-phase power line open. In the event that one leg of the three-phase voltage is lost, the potential voltage from the remaining two legs is rectified by a rectifying diode. This rectified voltage charges a capacitor until the voltage buildup reaches approximately 20 to 24 volts. When this voltage is reached, a four layer

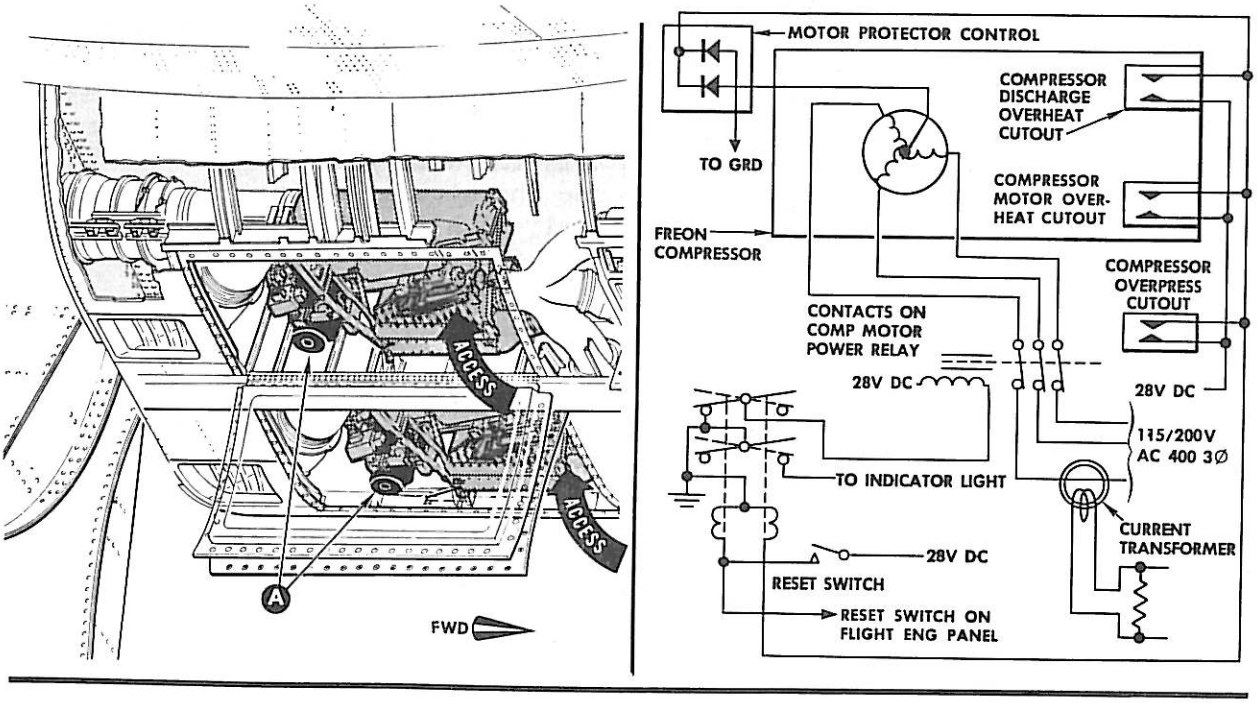


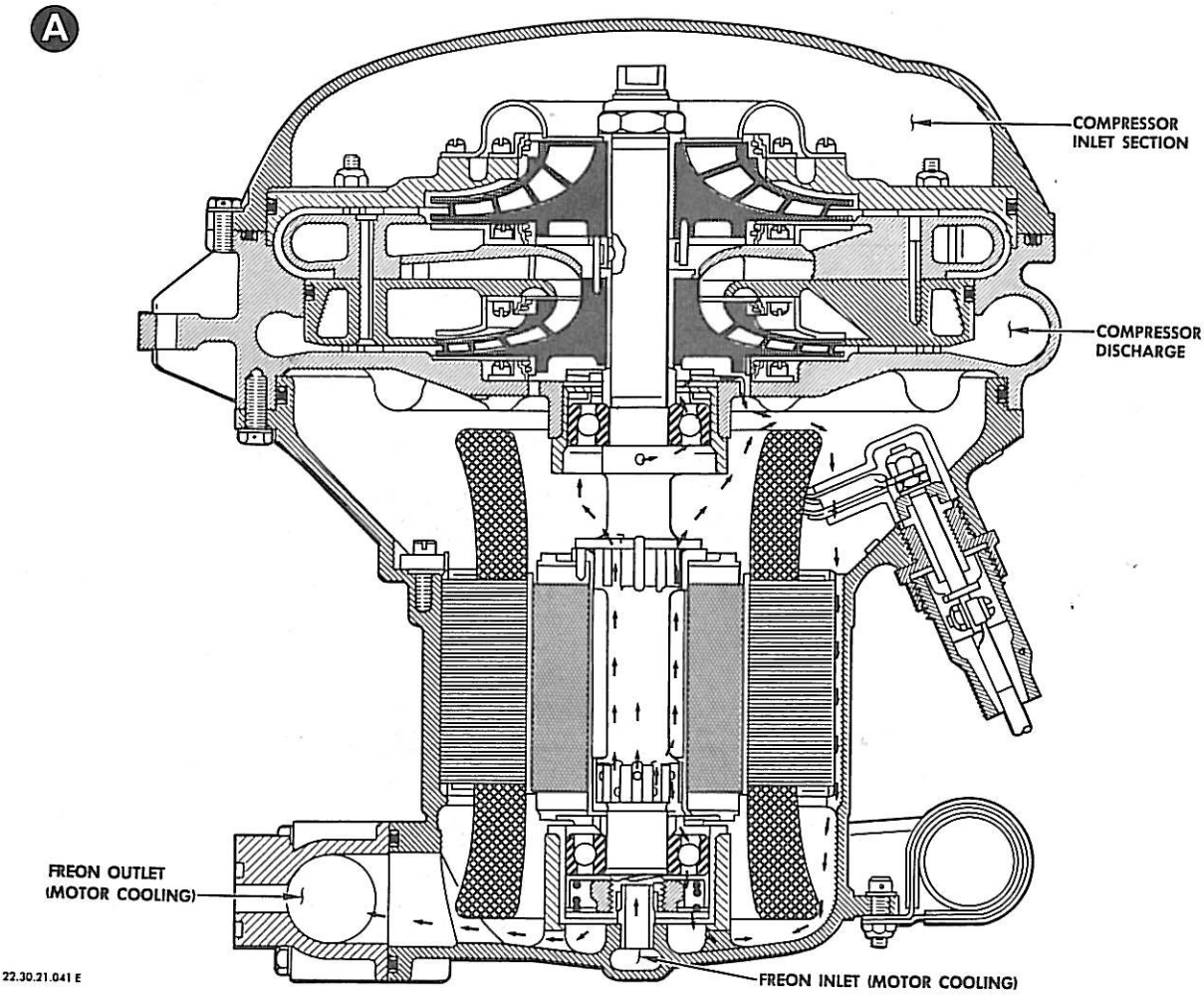
7. HEAT EXCHANGER
8. CONDITIONED AIR CHECK VALVE
9. FREON EVAPORATOR
10. CONDITIONED AIR EMERGENCY SHUTOFF VALVE
23. FREON CONDENSER
24. FREON EXPANSION VALVE
25. BACK PRESSURE REGULATOR VALVE
26. MOTOR COOLING EXPANSION VALVE
30. CONDENSER GROUND COOLING AIR SHUTOFF VALVE
31. CONDENSER COOLING AIR MODULATING VALVE
45. ELECTRONIC TEMPERATURE CONTROL
55. AIR FLOW SENSOR AND TRANSMITTER
63. ELECTRIC HEATER
64. FREON COMPRESSOR
65. CONDENSER FAN
115. WATER SEPARATOR

203. FREON DRIER AND STRAINER
204. FREON COMPRESSOR SURGE VALVE
205. THERMAL RESISTOR
208. TEMPERATURE SELECTOR
209. CONDENSER TEMPERATURE CONTROL
211. SEQUENCING DEVICE
221. FREON COMPRESSOR SURGE CONTROL
225. BELLOWS CONTROL
229. RELIEF VALVE
230. FREON LEVEL GAGE
250. MASS FLOW INDICATOR
253. 160° SWITCH
259. ELECTRONIC BACK PRESSURE CONTROL
261. CURRENT TRANSFORMER
264. LOCKOUT RELAY
272. PRESSURE SWITCH
277. THERMAL RESISTOR
293. MOTOR PROTECTOR CONTROL
295. FREON FILTER

22.35.21.223B

Freon Refrigeration System Schematic
Figure 1


ACCESS
ACCESS
A
FWD
MOTOR PROTECTOR CONTROL
TO GRD
FREON COMPRESSOR
COMPRESSOR DISCHARGE OVERHEAT CUTOUT
COMPRESSOR MOTOR OVER-HEAT CUTOUT
COMPRESSOR OVERPRESS CUTOUT
CONTACTS ON COMP MOTOR POWER RELAY
28V DC
28V DC
115/200V AC 400 3Ø
TO INDICATOR LIGHT
CURRENT TRANSFORMER
28V DC
RESET SWITCH
RESET SWITCH ON FLIGHT ENG PANEL


A
COMPRESSOR INLET SECTION
COMPRESSOR DISCHARGE
FREON OUTLET (MOTOR COOLING)
FREON INLET (MOTOR COOLING)
22.30.21.041 E

diode, acting as a switch, will break down and complete the circuit. The capacitor then discharges and applies its voltage through the diode to energize the Freon compressor lockout relay. If during compressor operation any of these conditions occur, the lockout relay terminates the 28-volt dc power to the motor power relay to shut down the compressor. A thermister (compressor start time delay) is installed in the compressor motor relay circuit. The thermister prevents the compressor motor from starting simultaneously with the condenser fan motor when power is supplied to operate the Freon system.

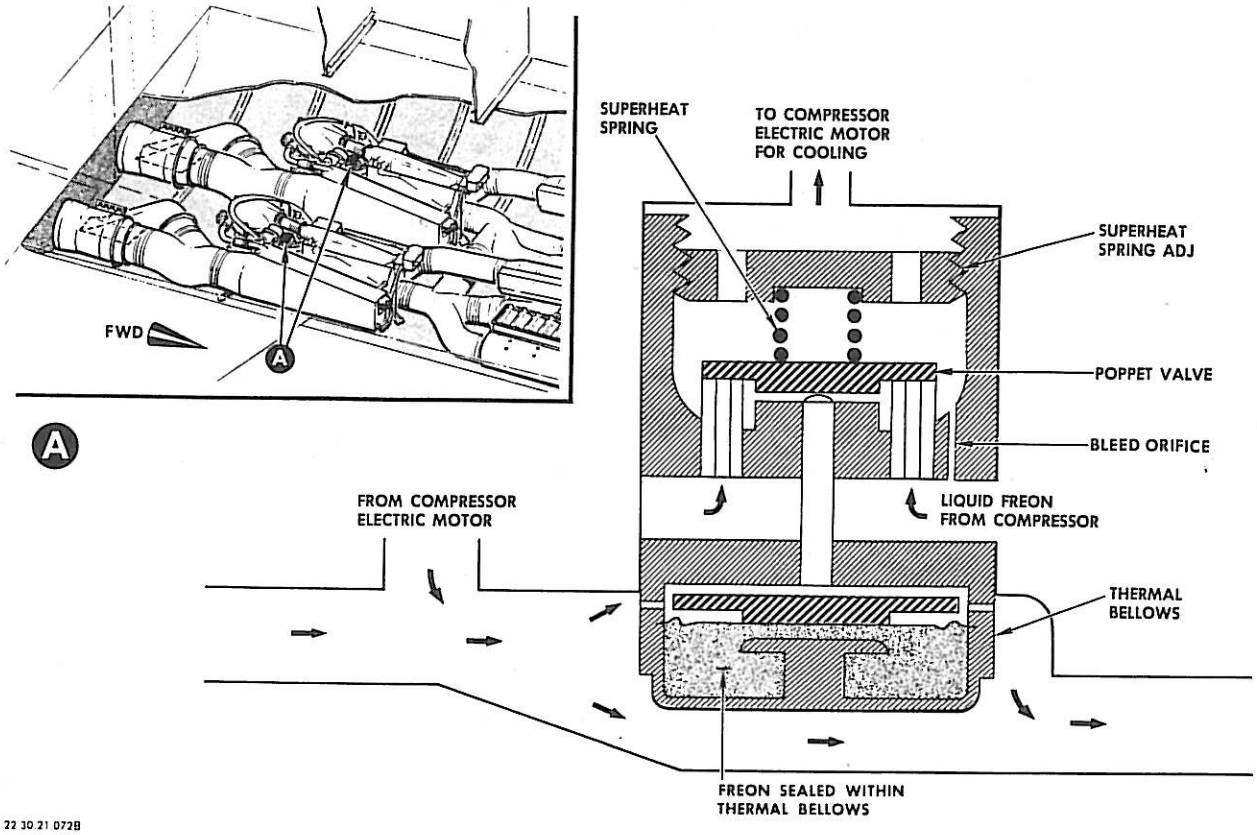
3. Motor Cooling Expansion Valve

A. Description.

The motor cooling expansion valve, shown on Figure 3, is an integral part of the freon compressor. The valve consists of a thermal bellows which is connected to a poppet valve. The valve also contains an integral bleed orifice. The poppet valve is spring-loaded by a superheat spring. The portion of the valve which contains the thermal bellows is located in the discharge duct of the compressor bypass and motor housing. The thermal bellows is filled with Freon and is affected by the temperature and pressure of the evaporated gas.

B. Operation.

The motor cooling expansion valve controls the flow of Freon entering the compressor housing around the electric motor. A bleed orifice within the valve meters sufficient Freon to cool and lubricate the compressor motor and bearings during normal operation. When additional



Motor Cooling Expansion Valve
Figure 3

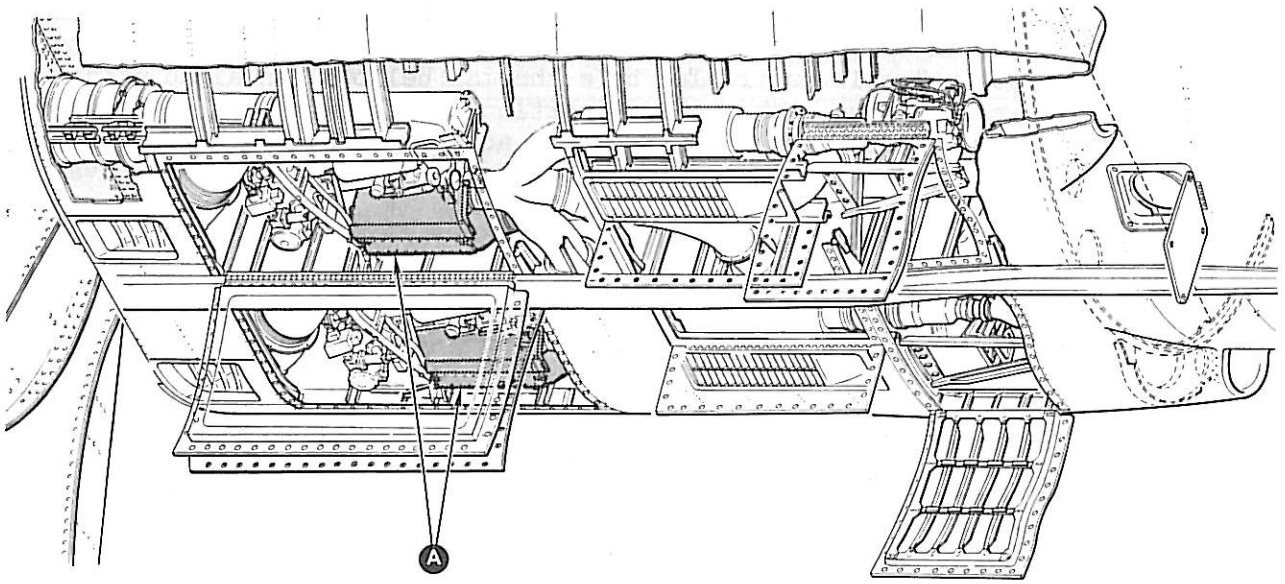
cooling of the motor and bearings is necessary, a poppet valve within the expansion valve opens and allows more Freon to enter the housing. The poppet valve is controlled by a thermal bellows contained within the expansion valve. The bellows portion of the expansion valve extends into the compressor bypass duct and is acted upon by the Freon leaving the motor housing and by the Freon bypassed by the surge control valve.

The thermal bellows contains the same type refrigerant as that used in the package and is affected by both the temperature and pressure of the evaporated gas as it flows past. The pressure of the evaporated Freon gas leaving the motor housing and Freon gas from the surge valve is admitted to the face of the thermal bellows by four ports in the valve housing located above the face of the bellows. Three resultant forces act on the poppet valve by means of the bellows and the superheat spring, to provide proper cooling as required. A pressure, tending to open the poppet valve, is exerted by the Freon contained in the bellows. A pressure, exerted by evaporated Freon on the face of the bellows, and the force of the superheat spring tend to close the poppet valve. If the cooling load of the motor increases, the temperature of the evaporated Freon leaving the motor housing increases. This causes the bellows to expand and open the valve, further allowing more Freon to pass into the motor housing in order to carry the higher cooling load. The pressure of the hot Freon gas against the face of the bellows will also increase, tending to close the valve and maintain evaporation at the saturation pressure above the motor. The pressure of the superheat spring tends to close the poppet valve. Its action assures that complete evaporation takes place by slowing down the flow through the motor housing and permitting additional heat to be added to the Freon after evaporation. The thermal bellows of the expansion valve is located in the bypass duct and is subject to high temperature Freon that is recirculated by the surge valve. Thus, during times of surge bypass, the motor is overcooled to permit the Freon from the motor housing to mix with the bypassed Freon and limit compressor inlet temperatures.

4. Freon Evaporator

A. Description.

The evaporator, shown on Figure 4, consists of a two-pass evaporator core and a quick-disconnect coupling. Two large air ducts protrude from the forward end of the evaporator body. Freon enters through the expansion valve distributor located near the bottom of the evaporator air inlet header. The Freon outlet header extends to the aft end of the evaporator and connects to the compressor inlet duct. The evaporator core is of the plate and fin design. The expansion valve distributor is connected to the evaporator Freon inlet header by twelve tubes. The evaporator core is arranged so that the Freon passages lead from the top of the cabin air discharge side of the core, down to a transfer header at the base, and up through the cabin air inlet side of the core to a common Freon collector. The air discharge header contains a water collector and a drain. The quick-disconnect coupling is located at the top of the evaporator. The coupling consists of a self-sealing socket containing a spring-loaded sliding ring and cap.



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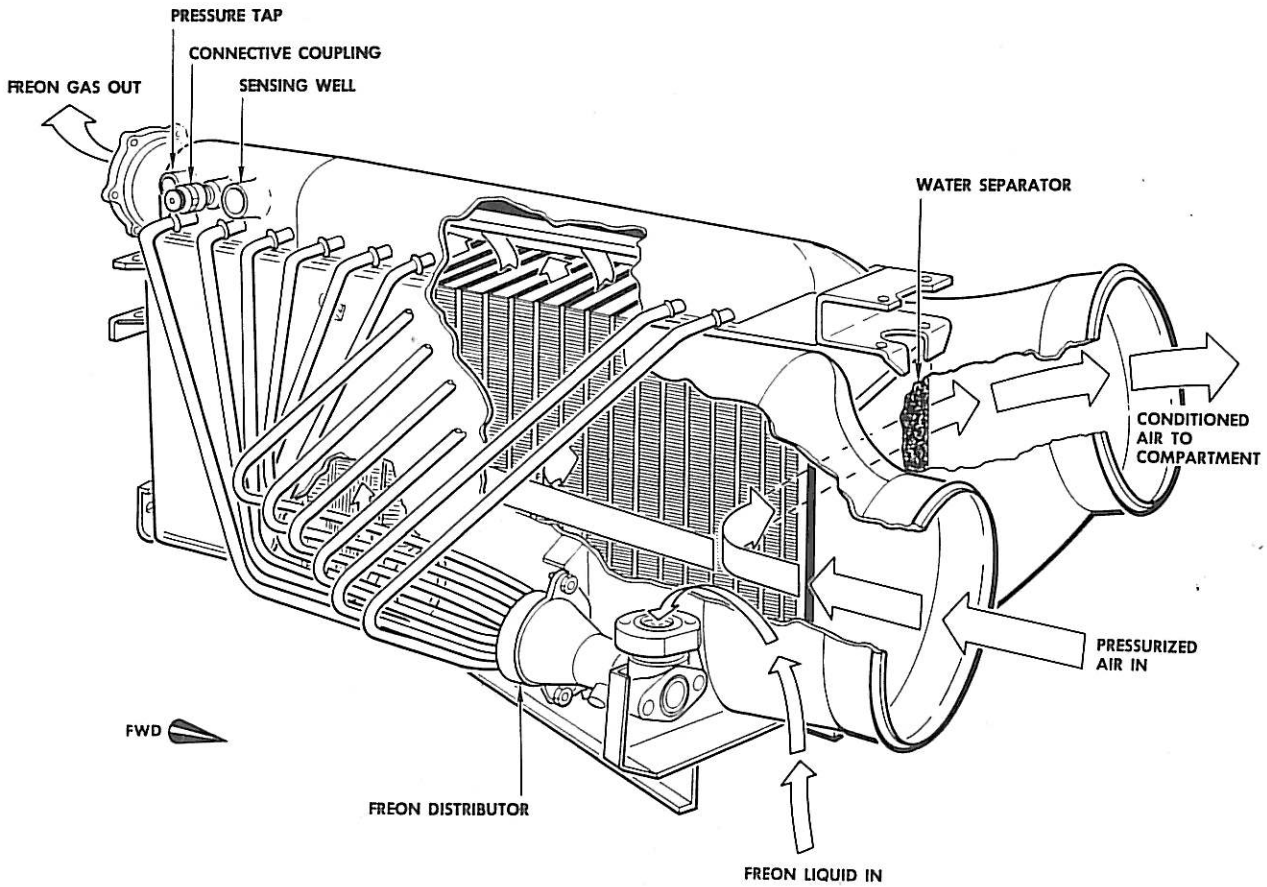


22.30.21.039B

FREON EVAPORATOR

B. Operation.

The Freon evaporator acts as a Freon-to-air heat exchanger. Air from the turbocompressor, or cabin recirculated air, flows horizontally over the Freon passage walls of the care. The liquid Freon is metered by the expansion valve to the twelve distributor tubes that supply the Freon inlet header at the top of the evaporator core at the cabin air outlet. The evaporating Freon, on the inside of the core, extracts heat from the air as it passes over the outside of the core, thus the air is cooled. Warm Freon gas collects in the collector at the top of the core at the cabin air inlet side and is drawn out by the Freon compressor.

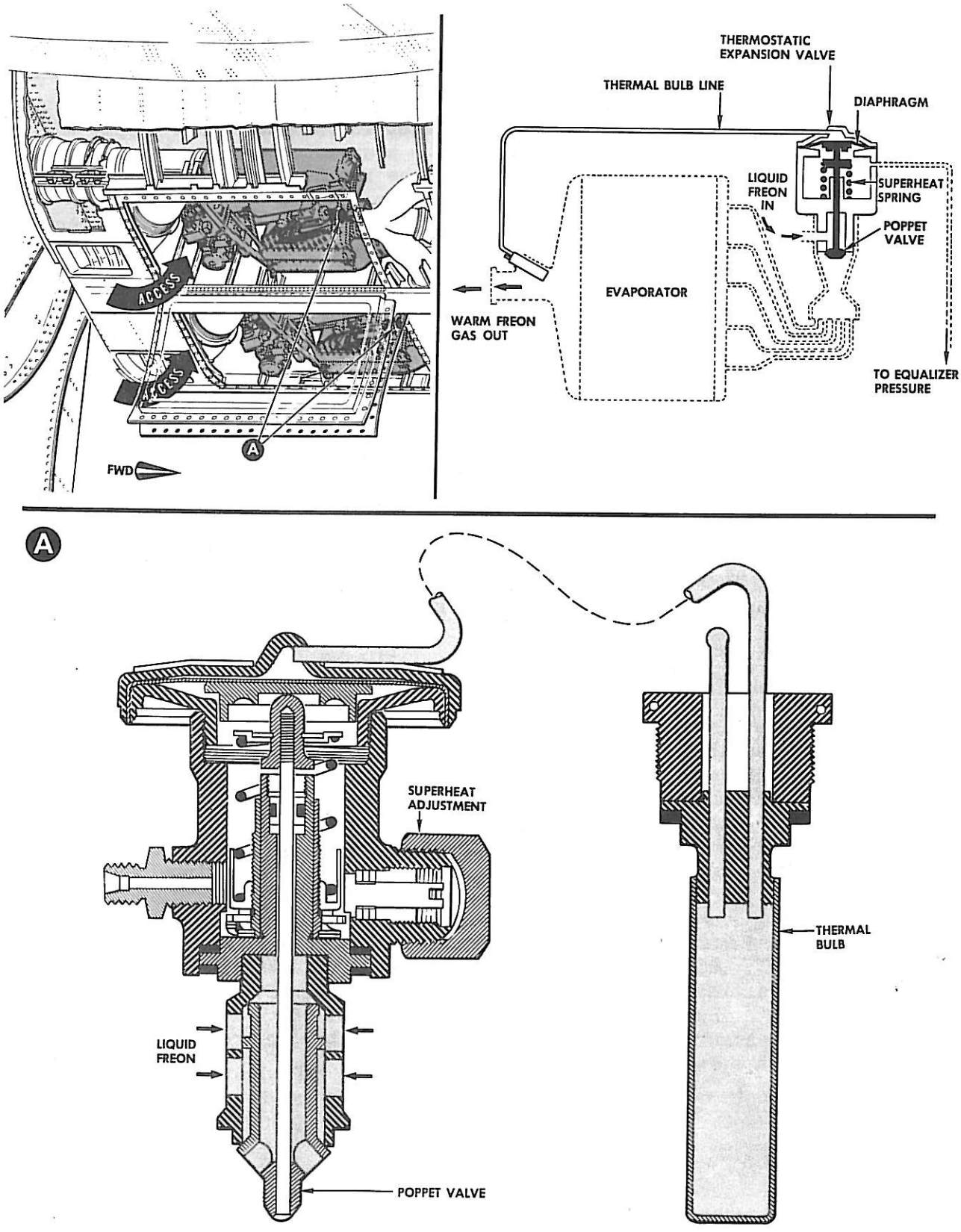
As the pressurized air is cooled the dewpoint of the air is reached. Water vapor in the air condenses as water droplets on the core surfaces and drains from the passages into a water collector. Cabin air pressure forces the water from the collector to a spray tube where it is sprayed over the ram air inlet side of the condenser core and is discharged overboard with the condenser cooling air.

The quick-disconnect coupling provides a means for attaching a pressure gage to observe evaporator Freon outlet pressure. The ring is manually depressed to permit the insertion of the cap when the coupling is not in use. The cap prevents foreign material from entering the socket. The cap is replaced by a standard Hansel 1-K11 plug to open the coupling and permit attachment of the pressure gage.

5. Freon Expansion Valve

A. Description.

The expansion valve is mounted near the bottom of the evaporator air inlet header. The valve, shown on Figure 5, consists of a thermo valve cage assembly, and thermo valve actuator and sensor. The cage is contained within the actuator housing and protrudes into the valve distributor head which is a part of the evaporator. A poppet with a bleed orifice is contained within the valve body and is spring-loaded to the closed position by a superheat spring. The actuator and sensor has a sensing line which is connected to a thermal sensing bulb in the evaporator Freon outlet header and to a sealed chamber behind a metal diaphragm. This sealed unit contains Freon isolated from the rest of the Freon in the refrigeration system. The upper end of the poppet shaft contacts the lower surface of the diaphragm of the actuator and sensor. An equalizer line connects the spring chamber to the outlet header on the evaporator.



Freon Expansion Valve
Figure 5

B. Operation.

In the main cooling loop, the Freon expansion valve regulates the flow of liquid Freon through the evaporator so that it leaves the evaporator completely evaporated and superheated.

The poppet valve is linked to a diaphragm which is exposed on one side to evaporated Freon gas pressure from the equalizer line. The opposite side of the diaphragm is exposed to pressure from an independent mass of gaseous Freon contained within the thermal bulb circuit. The pressure exerted on the diaphragm by the gas pressure from the equalizer line tends to close the poppet valve, while on the opposite side, pressure from the thermal bulb circuit tends to open the poppet. Thus, three forces act to operate the poppet valve: 1) the force from the Freon in the thermal bulb circuit created by the temperature of the evaporated Freon as it leaves the evaporator, 2) the force exerted by evaporator pressure through the equalizer line, and 3) the force from the superheat spring. The three forces on the diaphragm attain a point of balance for operation. When the evaporator is operating at a temperature of 35 degrees F or a pressure of 13.7 psia, and the Freon gas leaving the evaporator at the thermal bulb location is 45 degrees F, a condition of 10 degrees F superheat exists. Since the thermal bulb circuit is charged with Freon 114, its pressure will follow the saturation pressure-temperature characteristics of the Freon package. With the thermal bulb at 45 degrees F, the pressure exerted against the diaphragm by the thermal bulb circuit will be 17 psia and will tend to open the poppet valve.

On the opposite side of the diaphragm and acting to close the poppet valve are the evaporator pressure from the equalizer line (13.7 psia) and the force of the superheat spring (equivalent to a 10 degree F superheat setting of 3.3 psia). Thus, the valve is in balance with 17 psia above the diaphragm and the equivalent of 17 psia below the diaphragm. If the cooling load through the evaporator increases, the Freon temperature at the evaporator outlet increases. The pressure in the thermal bulb circuit increases because it is sensing a higher temperature. This increased pressure opens the poppet valve, further allowing more Freon to pass in order to carry the higher cooling load and maintain a relatively constant superheat. Conversely, a decrease in the cooling load of the evaporator will cause the poppet valve to move in a closing direction.

When the Freon package is shut down and the Freon compressor stops, evaporator pressure builds up and tends to equalize the pressure of the thermal bulb circuit. This increase in evaporator pressure, and the force of the superheat spring, overcomes the pressure of the thermal bulb circuit and closes the poppet valve. This function is important for it prevents the evaporator from flooding with liquid Freon when the Freon package is shut down.

Definition of Superheat:

Superheat is the temperature increase of the Freon gas above saturation temperature at the existing pressure. For example, an evaporator operating with Freon 114 at 13.7 psia outlet pressure will have a saturation temperature of 35 degrees F. As long as the boiling Freon, at any given point in the evaporator exists at this pressure, the temperature at that point will remain at 35 degrees F. As the liquid Freon moves along in the core of the evaporator, the liquid is boiled into a vapor by the heat it extracts from the conditioned air. The gas continues to the end of the evaporator core under the same pressure of 13.7 psia; however, its temperature increases due to heat pickup after boiling is completed while travelling to the end of the core and its temperature becomes 45 degrees F. The gas is considered to be superheated and the amount of superheat is 10 degress F. Superheat is added to the Freon in the evaporator to assure complete evaporation of the liquid Freon and to prevent liquid Freon from entering the compressor.

6. Freon Condenser

A. Description.

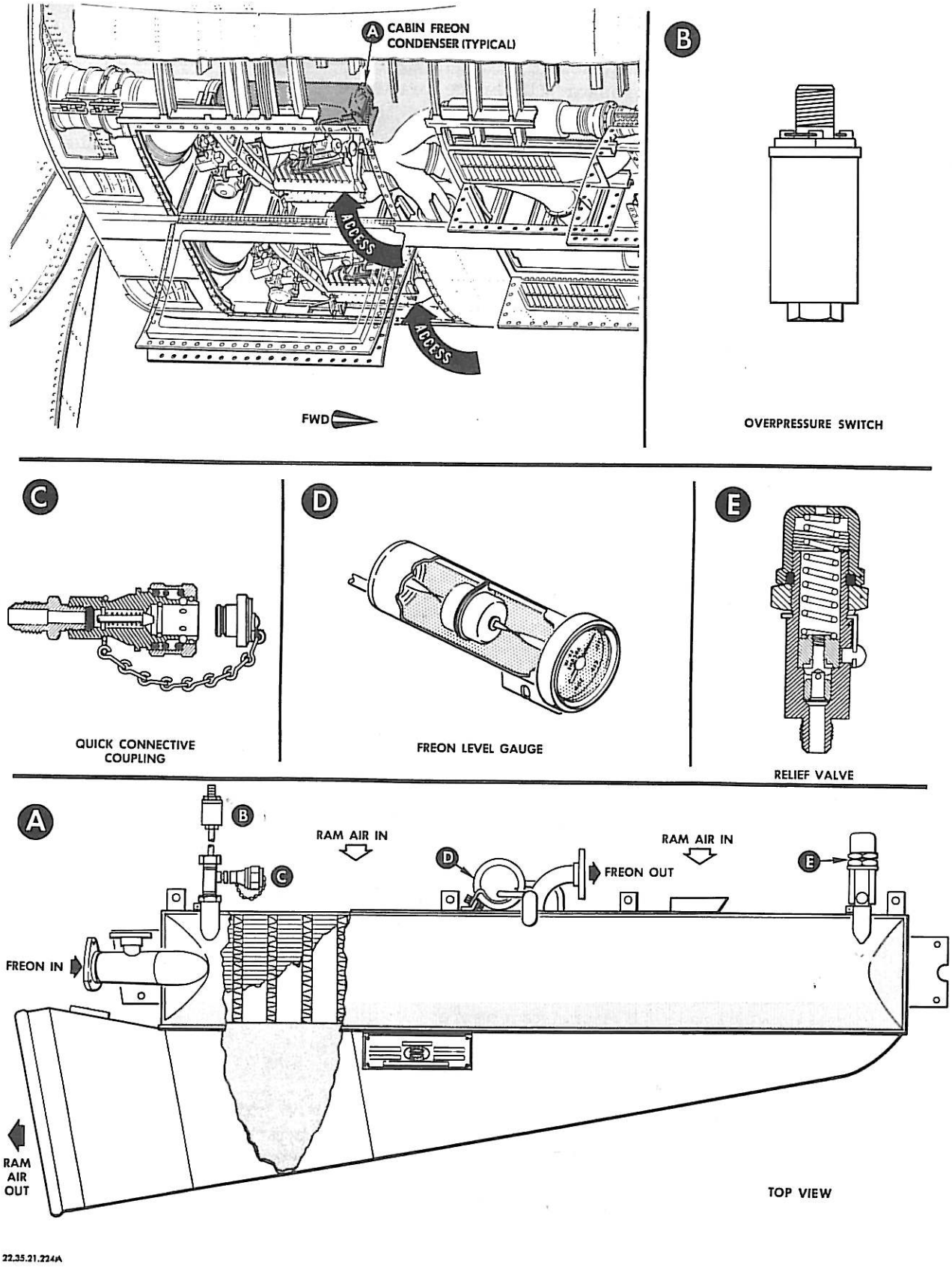
The Freon condenser, shown in Figure 6, consists of a core, purge valve, drain plug, a relief valve, and a liquid level gage. The ram air inlet is an open side toward the evaporator. A ram air outlet header provides for duct connection on the aft end of the condenser. The Freon inlet header at the top of the condenser has an inlet port and a bypass port connection. The Freon outlet, or receiver, is at the base of the condenser, and connects to the Freon drier and strainer. The condenser core is of the plate and fin design.

A quick-disconnect coupling is located at the top of the condenser. The coupling consists of a self-sealing socket containing a spring-loaded sliding ring and cap. The ring is manually depressed to permit the insertion of the cap when the coupling is not in use. The cap prevents foreign material from entering the socket.

A relief valve containing a spring-loaded poppet is located at the top of the condenser. A Freon level gage is mounted between the top inlet header and the receiver, with the gage visible from the lower side of the condenser.

B. Operation.

The condenser functions as a Freon-to-air heat exchanger to cool the hot Freon gas under pressure; this enables the Freon to condense into a liquid, and subcool it to prevent it from flashing back into a gas before reaching the expansion valve. The hot Freon gas enters the core at the top and condenses into a liquid while flowing down through the core. The Freon is cooled by the air flowing through the passageways in the condenser core, and by the evaporation of water which is sprayed over the ram air inlet surface of the core from the evaporator water spray tube.


A CABIN FREON CONDENSER (TYPICAL)
ACCESS
ACCESS
FWD
B
OVERPRESSURE SWITCH
C
QUICK CONNECTIVE COUPLING
D
FREON LEVEL GAUGE
E
RELIEF VALVE
A
B
C
D
E
RAM AIR IN
RAM AIR IN
FREON OUT
FREON IN
RAM AIR OUT
TOP VIEW
22.35.21.224A

The quick-disconnect coupling at the top of the condenser is at the highest point in the Freon package. The coupling is used primarily for purging air from the package and can also be used to attach a pressure gage. A Freon compressor discharge pressure line is also connected to the same pressure outlet fitting as the quick-disconnect coupling.

The relief valve has a set relief pressure point which is above the normal operating range of the package. It will open to release Freon to atmosphere should a system malfunction cause an excessive pressure differential between the inside and the outside of the condenser. A small rubber plug inserted in the relief valve vent provides a visual indication whether or not excessive pressures have developed. If the plug is blown out of the vent, excessive pressures have occurred and the Freon level should be checked, and the package should be given an operational check. The Freon level gage provides a visual indication of the amount of Freon in the condenser. The liquid Freon in the condenser moves a float which in turn positions a pointer over a graduated dial.

7. Freon Drier and Strainer

A. Description.

The Freon drier and strainer, shown on Figure 7, is a cylindrical unit that consists of a housing, a cartridge consisting of a can shaped filter screen filled with a chemical desiccant, an access cover, and outlet ducting. The housing has a mounting flange on one end for mounting to the condenser. The Freon outlet end of the housing is connected to a loop formed duct which connects to the evaporator Freon inlet port flange. The Freon passes through the strainer and drier cartridge where foreign meterial is removed by the strainer and traces of moisture are removed by the desiccant.

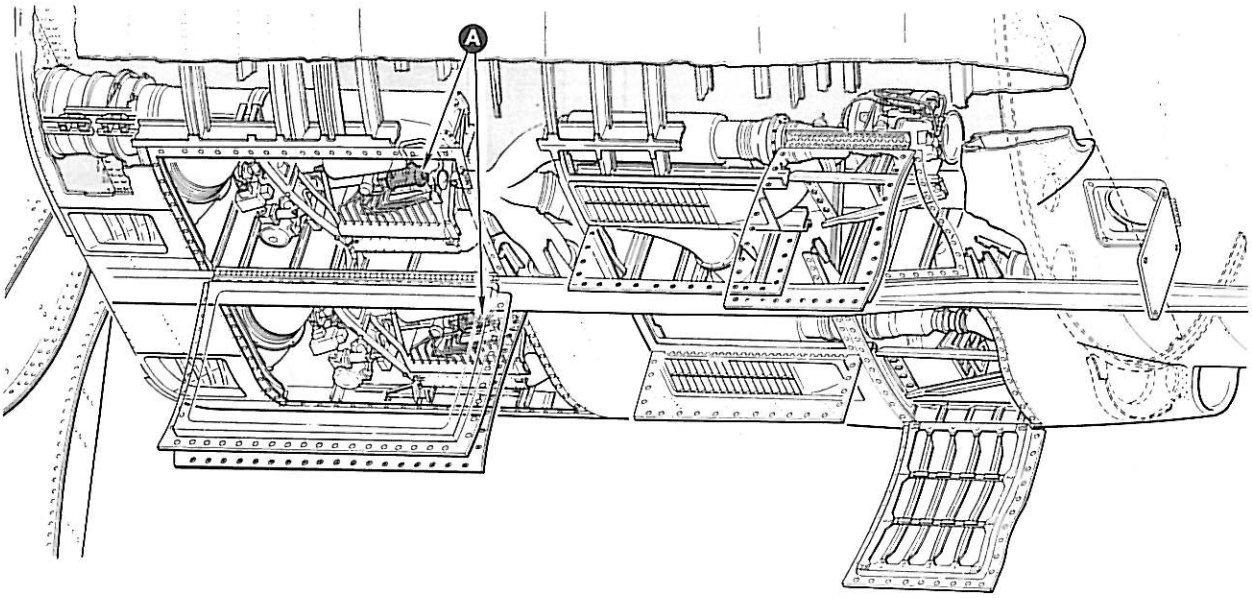
8. Freon Compressor Surge Control

A. Description.

The Freon compressor surge control, shown on Figure 8, consists of two diaphragm-separated chambers, a poppet valve, a piezometer ring and probe and a pickup flange. A central adjustment boss contains a seal, adjusting screw, and cap on one side, and a sealing diaphragm on the other. The central chamber, located between the two diaphragms, is connected to the probe in the pickup flange. The lower chamber is between the large diaphragm-operated piston and the poppet valve. The piezometer ring, which measures static pressure, is connected to this chamber. The poppet valve is spring-loaded to the closed position. When held open, it connects compressor outlet pressure to the surge valve.

B. Operation.

The surge control senses Freon flow through the main cooling loop at the compressor outlet to modulate the Freon compressor surge valve whenever compressor flow is reduced to a predetermined value. Total compressor outlet pressure is picked up by the probe and is supplied to the center chamber between the two diaphragms.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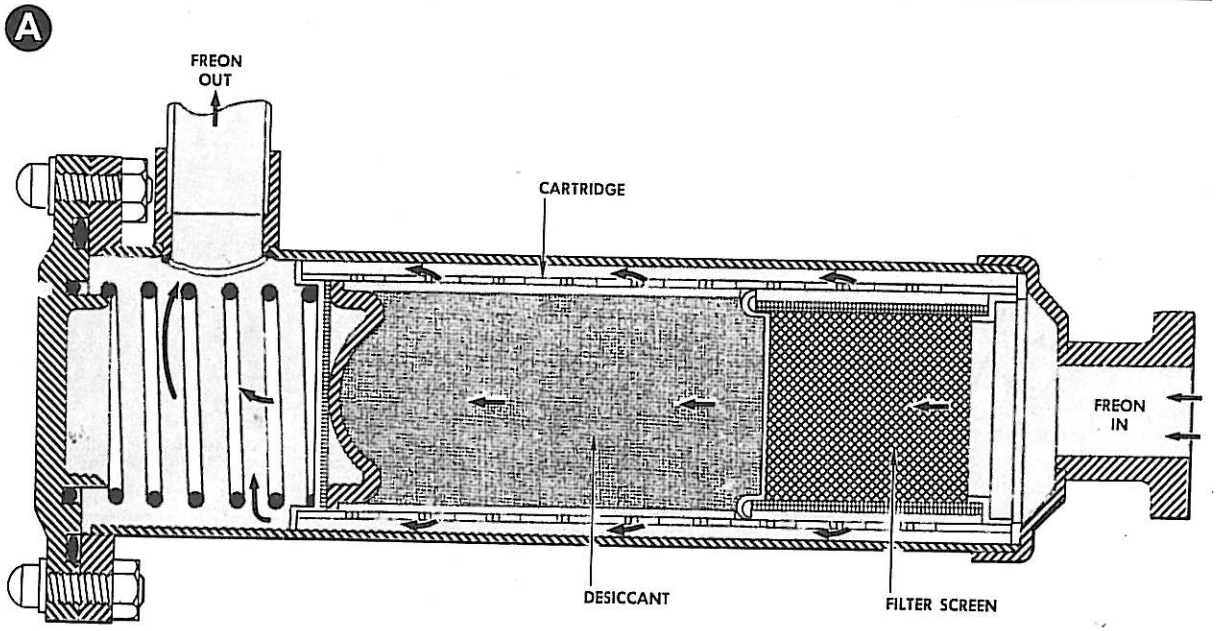
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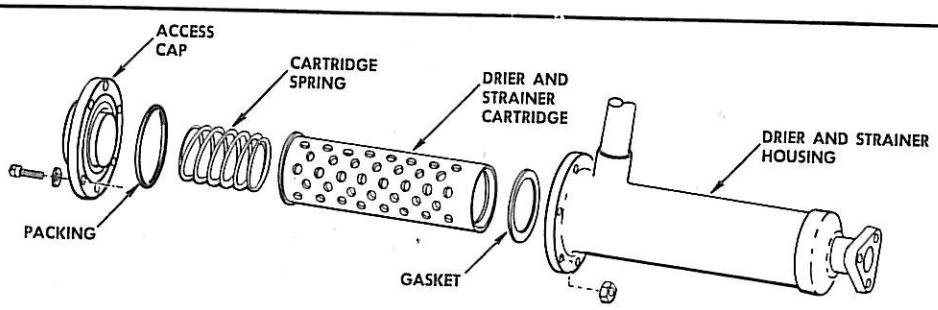
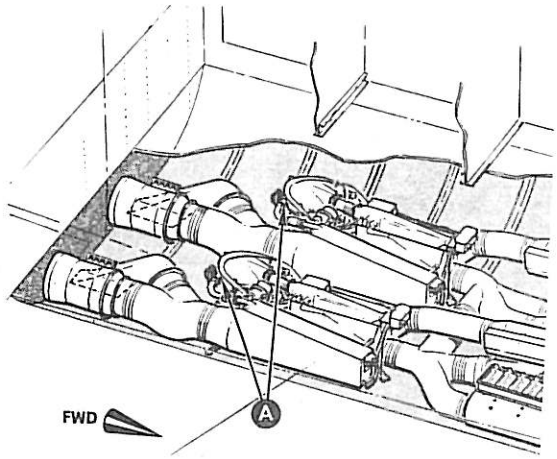
FREON OUT
CARTRIDGE
FREON IN
DESICCANT
FILTER SCREEN


ACCESS CAP
CARTRIDGE SPRING
DRIER AND STRAINER CARTRIDGE
DRIER AND STRAINER HOUSING
PACKING
GASKET

22.30.21.062 A


FWD
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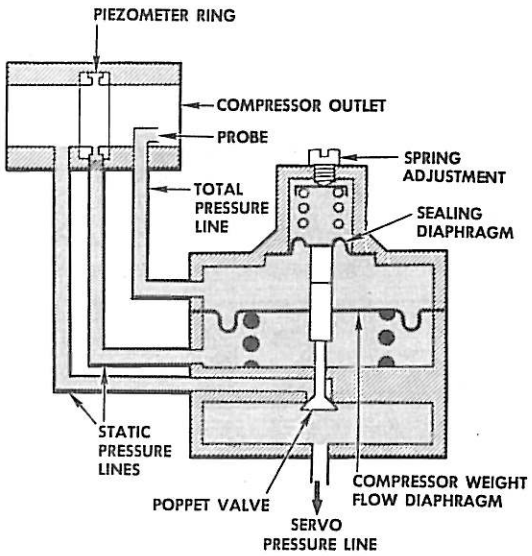
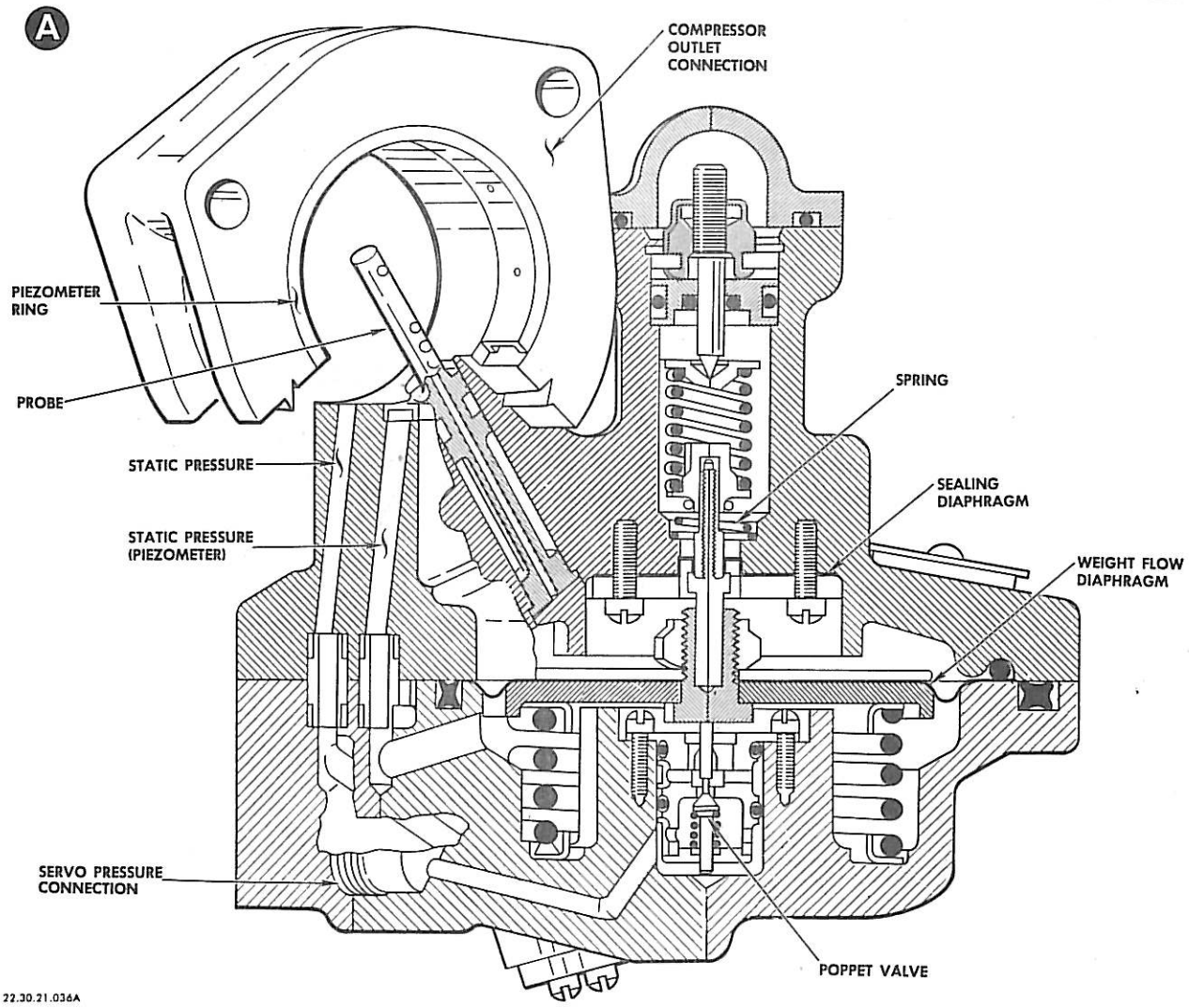

PIEZOMETER RING
COMPRESSOR OUTLET
PROBE
SPRING ADJUSTMENT
TOTAL PRESSURE LINE
SEALING DIAPHRAGM
STATIC PRESSURE LINES
POPPET VALVE
COMPRESSOR WEIGHT FLOW DIAPHRAGM
SERVO PRESSURE LINE


A
COMPRESSOR OUTLET CONNECTION
PIEZOMETER RING
PROBE
STATIC PRESSURE
STATIC PRESSURE (PIEZOMETER)
SPRING
SEALING DIAPHRAGM
WEIGHT FLOW DIAPHRAGM
SERVO PRESSURE CONNECTION
POPPET VALVE
22.30.21.036A

Static pressure obtained by compressor outlet flow through a piezometer ring is supplied to the chamber isolated by the large diaphragm. Static compressor outlet pressure, through a separate channel, is applied to the poppet valve for regulation as servo pressure for the surge valve. Movement of the diaphragm is caused by the difference between pressures in the chambers. Total pressure is always greater than static pressure, and their pressure differential increases as the weight flow increases. The area of the diaphragm is so established that the resultant combination of total and static pressures will tend to close the poppet valve whenever critical weight flows are approached.

9. Freon Compressor Surge Valve

A. Description.

The compressor surge valve is mounted on the compressor housing where the compressor bypass inlet joins the surge bypass tube. The valve, shown on Figure 9, contains a spring-loaded poppet valve attached to a diaphragm-operated piston. A control tube is ducted to the chamber formed between the diaphragm and the valve cap. The chamber is connected to the valve outlet flange through an orifice in the valve body. The poppet is spring-loaded in the valve open position.

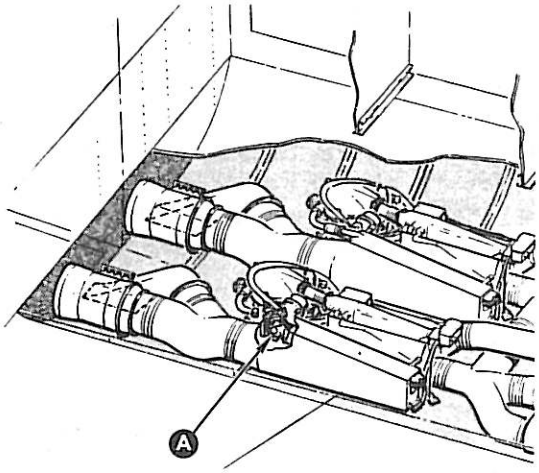
B. Operation.

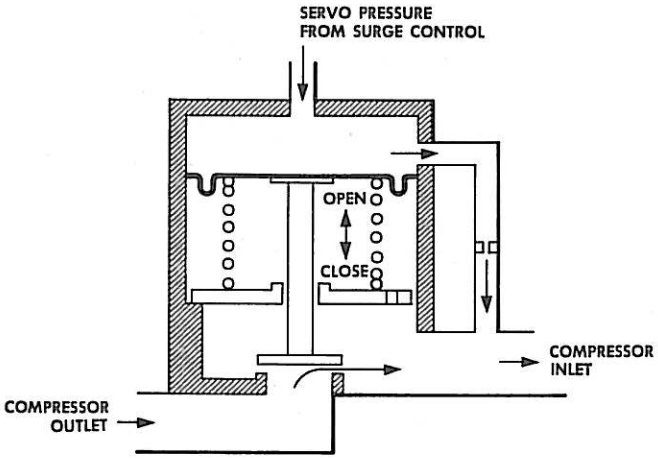
The compressor surge valve permits Freon flow between the compressor outlet and inlet at times of limited Freon weight flow through the normal cooling loop. The diaphragm chamber is supplied with servo pressure from the surge control to close the poppet valve. The servo pressure within this chamber is bled off through the choked orifice to the compressor inlet. When compressor weight flow decreases to a minimum acceptable value, the resulting decreased servo pressure against the servo valve diaphragm permits the spring to move the diaphragm. This action opens the poppet valve to recirculate Freon through the compressor and prevent compressor surging.

10. Back Pressure Regulator Valve

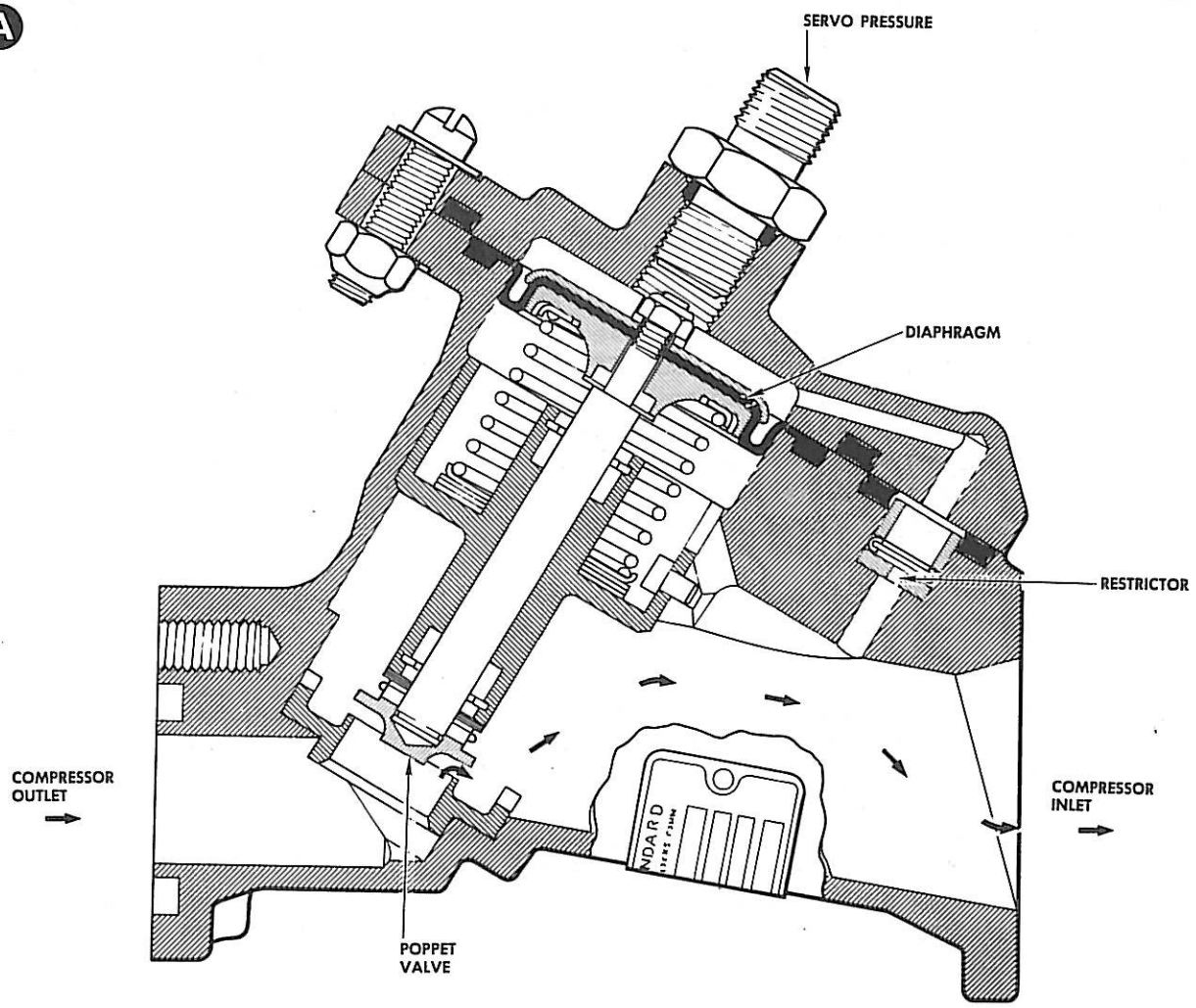
A. Description.

The back pressure regulator is connected to the Freon compressor inlet. The valve, shown on Figure 10, consists of a housing containing an electric actuator splined to a butterfly valve. The actuator is hermetically sealed within the valve housing. Freon seepage into the sealed chamber from around the valve shaft is evacuated through a suction line connected to the Freon compressor inlet. The actuator's electric motor is mechanically coupled to a rate feedback potentiometer and a limit switch. The limit switch closes when the butterfly valve is closed.

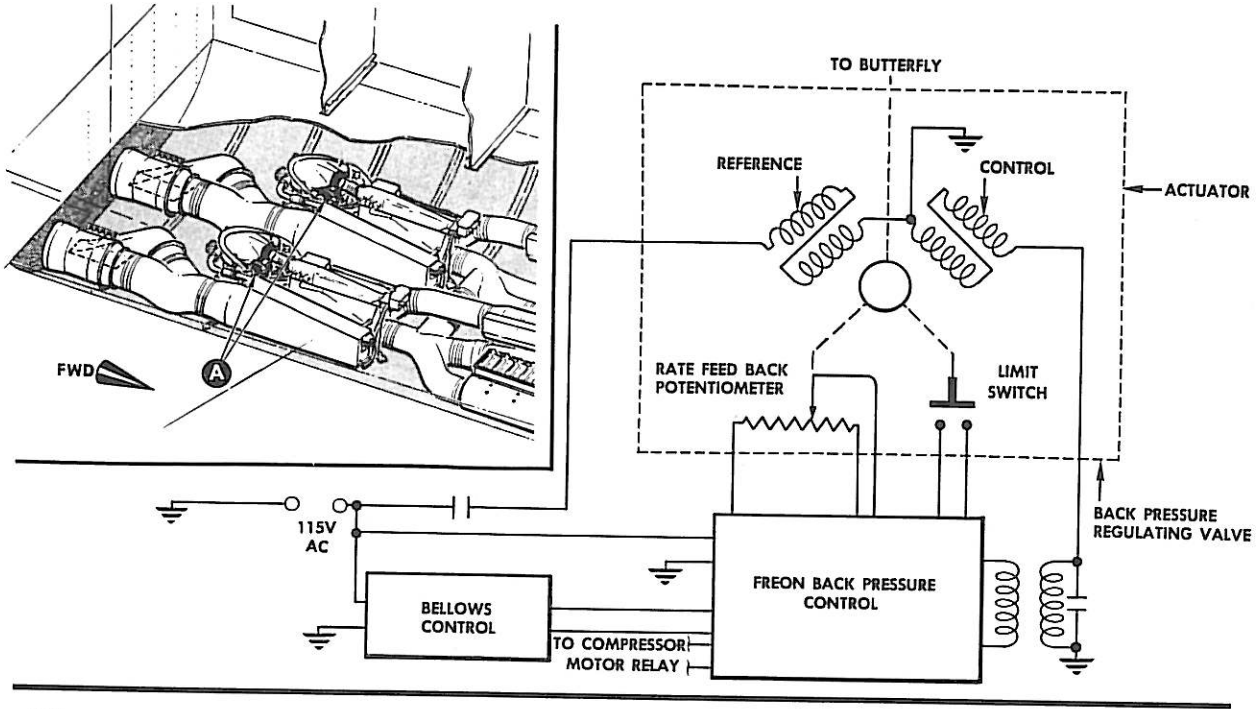

A

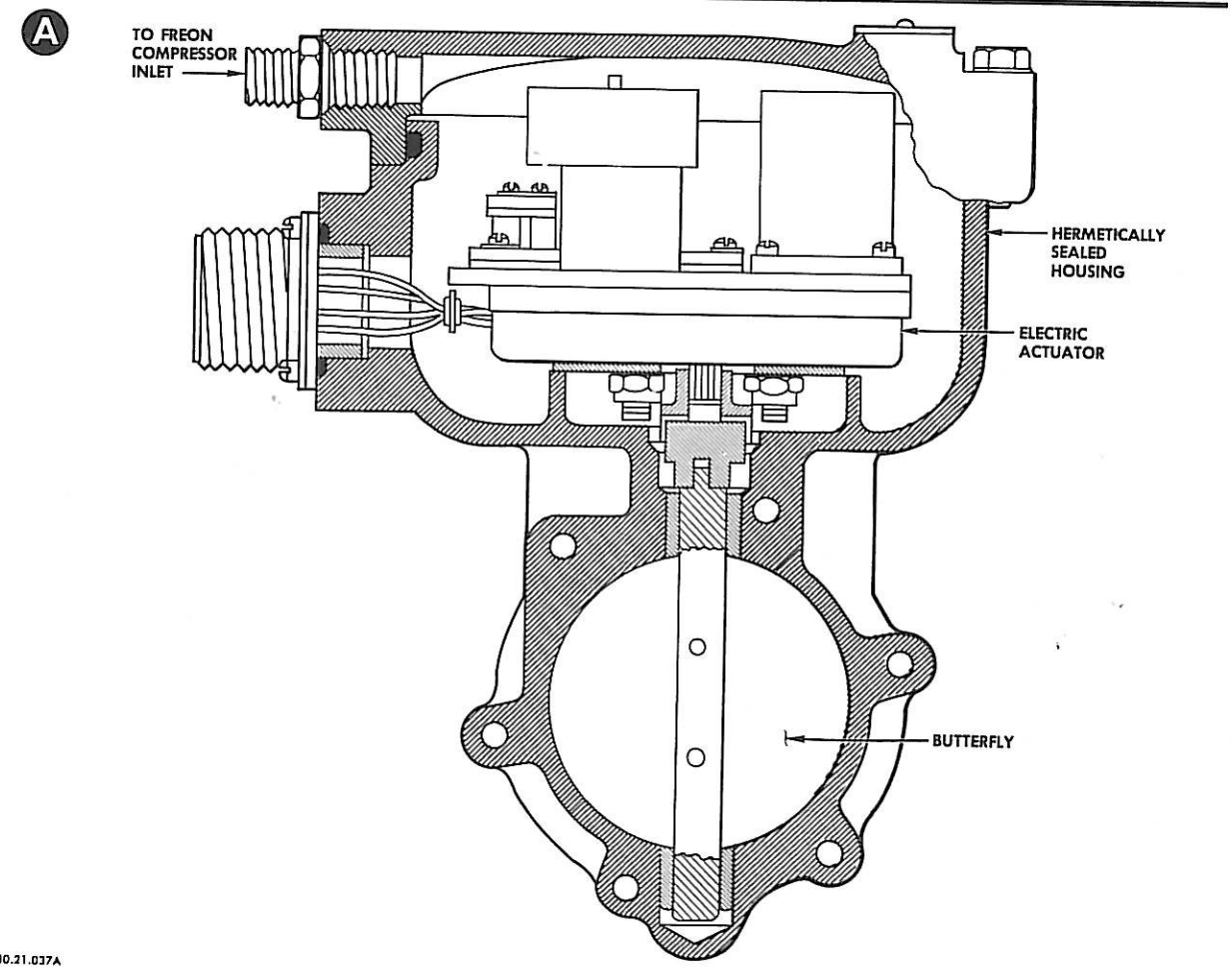

SERVO PRESSURE
FROM SURGE CONTROL
OPEN
CLOSE
COMPRESSOR
INLET
COMPRESSOR
OUTLET

A


SERVO PRESSURE
DIAPHRAGM
RESTRICTOR
COMPRESSOR
OUTLET
COMPRESSOR
INLET
POPPET
VALVE

22.30.21.082


FWD
A
TO BUTTERFLY
REFERENCE
CONTROL
ACTUATOR
RATE FEED BACK POTENTIOMETER
LIMIT SWITCH
115V AC
BELLOWS CONTROL
TO COMPRESSOR MOTOR RELAY
FREON BACK PRESSURE CONTROL
BACK PRESSURE REGULATING VALVE


A
TO FREON COMPRESSOR INLET
HERMETICALLY SEALED HOUSING
ELECTRIC ACTUATOR
BUTTERFLY

22.30.21.037A

B. Operation.

The valve actuator is operated by an electric servo motor having two phase windings. Motor rotation is determined by the difference between phase shifts of ac voltage applied to each winding. One phase winding is used as a reference voltage winding with an ac voltage from a power source connected to it. The other phase winding is used as a control winding and the phase of the voltage applied either leads or lags that phase at the reference winding. 115-volt ac power is capacitance coupled to the reference phase winding as reference voltage at all times. Control phase voltage is applied to the control phase winding as required to modulate the valve.

When Freon package operation is not scheduled, control voltage is ap-aplied continually to keep the valve closed. When package operation is scheduled, control voltage is applied by the electronic back pressure control to schedule valve position as required by the sequencing device. However, at the start of Freon package scheduling, the back pressure regulator valve must be closed so that its limit switch is in the closed position. The limit switch completes a circuit which permits the Freon compressor to start. Once the compressor is operating the switch is no longer utilized to complete the compressor relay circuit. When the compressor is shut down, a 28-volt dc bias is applied to the back pressure control to drive the back pressure regulator valve closed, closing the limit switch to allow system restart.

A signal is supplied from the bellows control to the back pressure control to provide either a leading or lagging phase control voltage to modulate the valve as scheduled by the sequencing device. The actuator rate feedback potentiometer provides a signal to the control so that it may regulate the rate of travel of the actuator motor.

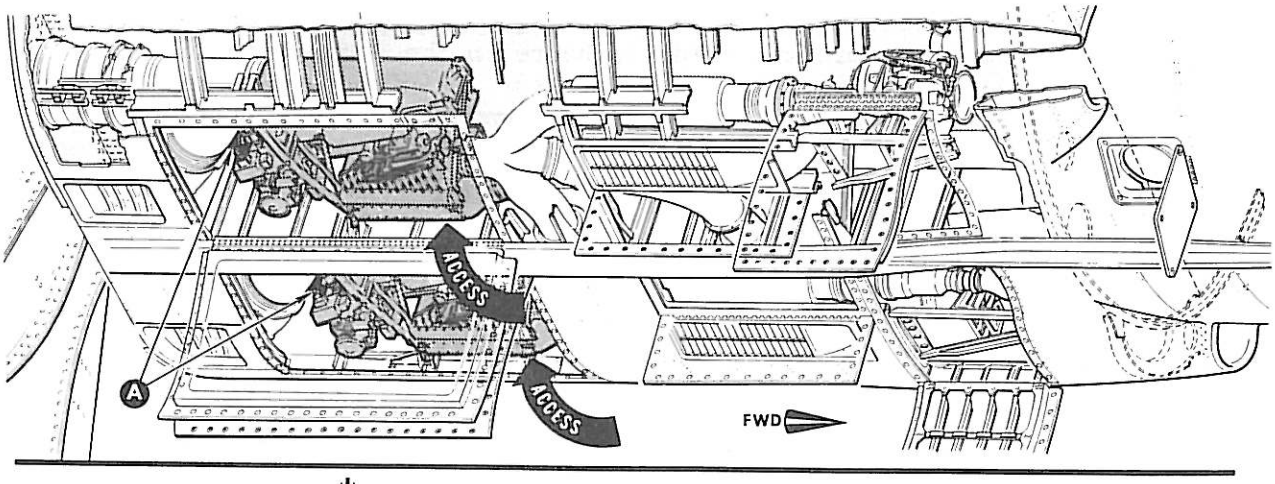
11. Bellows Control

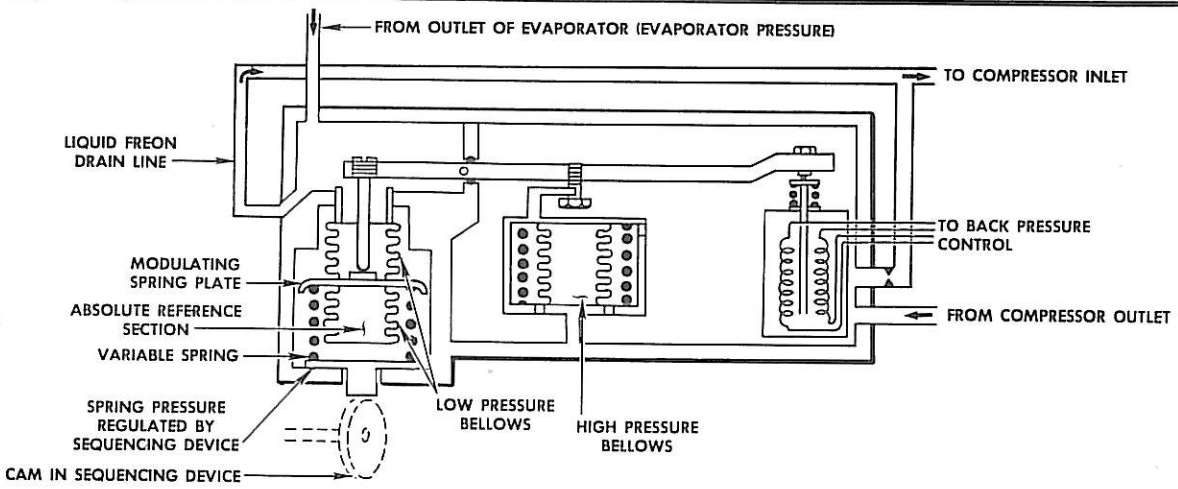
A. Description.

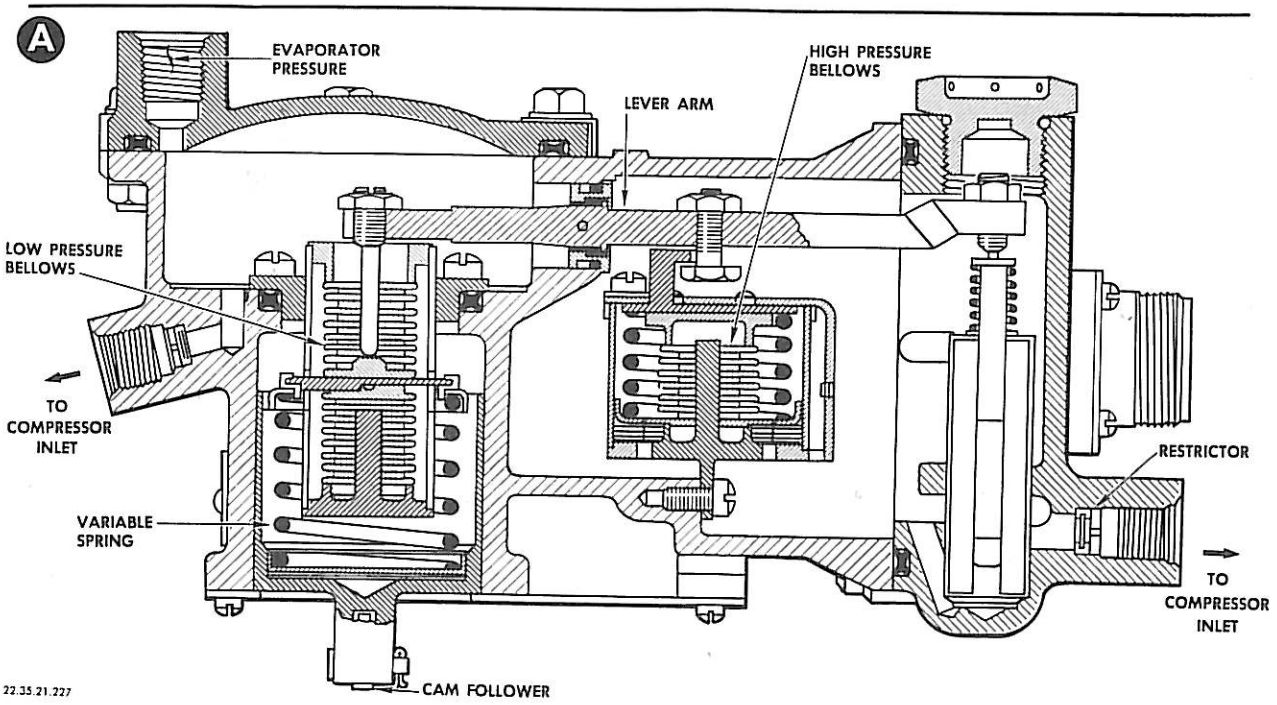
The bellows control, shown on Figure 11, is mounted on the Freon package aft frame and connects to the sequencing device. The control contains a high and low pressure bellows, each with a separate chamber, a cam follower, and a reluctance transformer. One electrical harness and four pressure lines connect the control to the Freon package. The harness connects the transformer to the Freon lockout relay and back pressure valve control. One chamber of the bellows control is connected to the Freon evaporator outlet pressure line and the other is connected to the compressor outlet. A cam follower, protruding from the bottom of the bellows control, contacts the sequencing device.

B. Operation.

The bellows control provides a signal which is translated into control phase voltage by the back pressure control and is applied to the back pressure regulator valve to regulate the Freon system cooling capacity.


ACCESS
ACCESS
A
FWD


FROM OUTLET OF EVAPORATOR (EVAPORATOR PRESSURE)
TO COMPRESSOR INLET
LIQUID FREON DRAIN LINE
TO BACK PRESSURE CONTROL
MODULATING SPRING PLATE
ABSOLUTE REFERENCE SECTION
VARIABLE SPRING
FROM COMPRESSOR OUTLET
SPRING PRESSURE REGULATED BY SEQUENCING DEVICE
LOW PRESSURE BELLOWS
HIGH PRESSURE BELLOWS
CAM IN SEQUENCING DEVICE


A
EVAPORATOR PRESSURE
HIGH PRESSURE BELLOWS
LEVER ARM
LOW PRESSURE BELLOWS
TO COMPRESSOR INLET
RESTRICTOR
VARIABLE SPRING
TO COMPRESSOR INLET
CAM FOLLOWER
22.35.21.227

Besides controlling the system cooling capacity, the bellows control also limits the minimum Freon pressure in the evaporator and the maximum outlet pressure from the compressor. Minimum evaporator pressure is maintained above a saturation temperature of 30 degree F to prevent the condensation from freezing on the air side of the evaporator core. Compressor outlet pressure is limited to a predetermined valve to limit compressor motor loads.

Freon pressure from the evaporator is bled into one section of the low pressure bellows to exert pressure on one side of a modulating spring plate. This pressure is compared to a force on the opposite side of the plate consisting of the absolute reference section in the low pressure bellows and a spring pressure. The pressure exerted by the spring is controlled by a cam in the sequencing device. The sequencing device regulates the spring force in relation to the demands of the temperature control. The modulating spring plate operates the reluctance transformer. Freon compressor outlet pressure is ducted to a high pressure chamber in the control containing the high pressure bellows and the reluctance transformer. The high pressure bellows is coupled to the reluctance transformer. The high and low pressure chambers of the bellows control are ducted to the compressor inlet through choked orifices. These compressor inlet lines tend to prevent the formation of liquid Freon in the chambers and provide a drain should liquid Freon form.

(1) Increase in Cooling.

When the temperature control signals for an increase in compartment cooling, the sequencing device cam rotates to decrease spring force on the modulating spring plate. This permits Freon pressure from the evaporator to move the spring plate against the reduced spring force. Movement of the spring plate in this direction causes the reluctance transformer to provide a signal to the back pressure control which further opens the back pressure regulator valve. The opening of the back pressure regulator valve decreases evaporator pressure. This results in decreased saturation temperature in the evaporator so that increased cooling of the air takes place. As evaporator pressure decreases, less pressure is applied to the low pressure bellows, resulting in a reduction of the "open" signal from the reluctance transformer. The changed evaporator pressure serves as a feedback signal, tending to halt the opening of the back pressure regulator valve and thereby setting the evaporator at the new low pressure. This action of the bellows control produces a steady state condition between evaporator pressure and the spring pressure being applied by the position of the sequencing device cam.

When the temperature control signals for full cooling capacity from the Freon package, the sequencing device is rotated so that its cam allows the cam follower to come to rest on the minimum temperature stop. The resulting spring pressure is sufficient to maintain Freon evaporator pressure above the Freon saturation pressure corresponding to 30 degrees F. Thus, freezing of condensate on the evaporator will not take place.

(2) Decrease in Cooling.

When the temperature control signals for a decrease in compartment cooling, the sequencing device cam increases spring pressure on the modulating spring plate. This moves the core of the reluctance transformer, which provides a signal to close the back pressure regulator valve. Closing the valve increases evaporator pressure, which balances the new spring force on the modulating spring plate and does not allow the valve to fully close. When the spring pressure against the modulating spring plate equals the evaporator pressure against the opposite side of the spring plate a steady state condition exists.

The evacuated section of the low pressure bellows provides an absolute reference for the evaporated Freon pressure against the face area of the low pressure bellows. The inclusion of this evacuated section prevents the low pressure bellows from being affected by changes in atmospheric pressure by isolating the face area from ambient. This method assures that minimum saturation pressure within the evaporator, as determined by the adjustment of the minimum temperature stop, will be the same at all altitudes.

Should the compressor outlet pressures become excessive due to a malfunction in the vapor cycle system, pressure surrounding the high pressure bellows causes it to start compressing. Compressing the bellows moves the core of the reluctance transformer in a direction to provide a signal to the back pressure control, which tends to close the back pressure regulator valve thereby reducing compressor outlet pressure. Should compressor outlet pressure reach 160 psia, an overpressure switch (external to the bellows control) actuates and shuts down the Freon compressor.

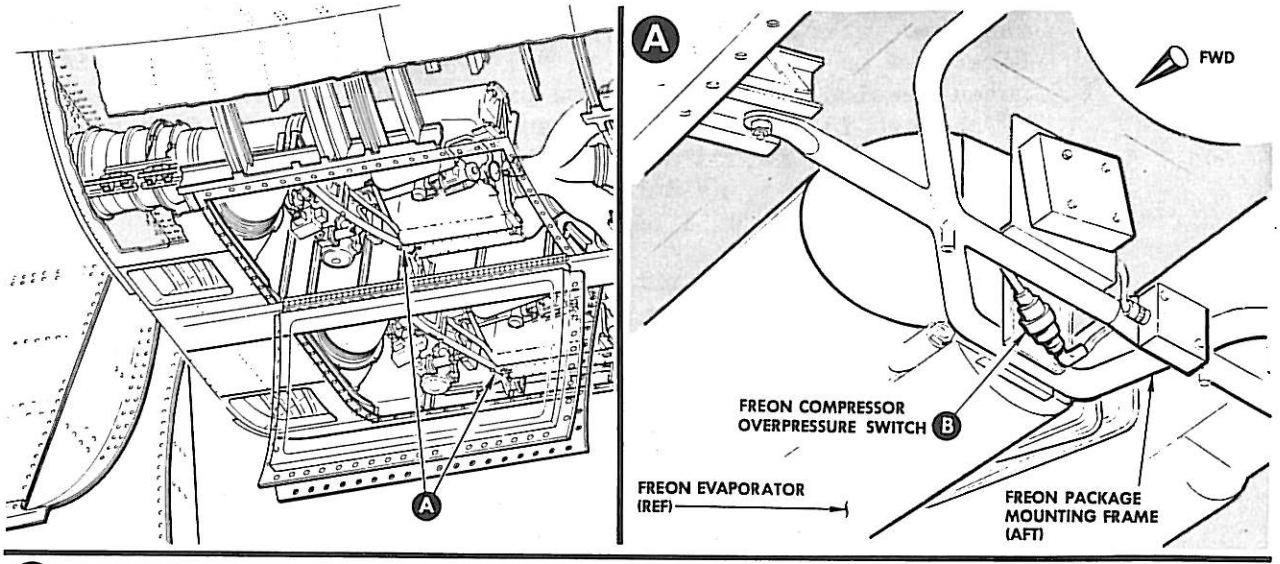
11A. Freon Compressor Overpressure Switch

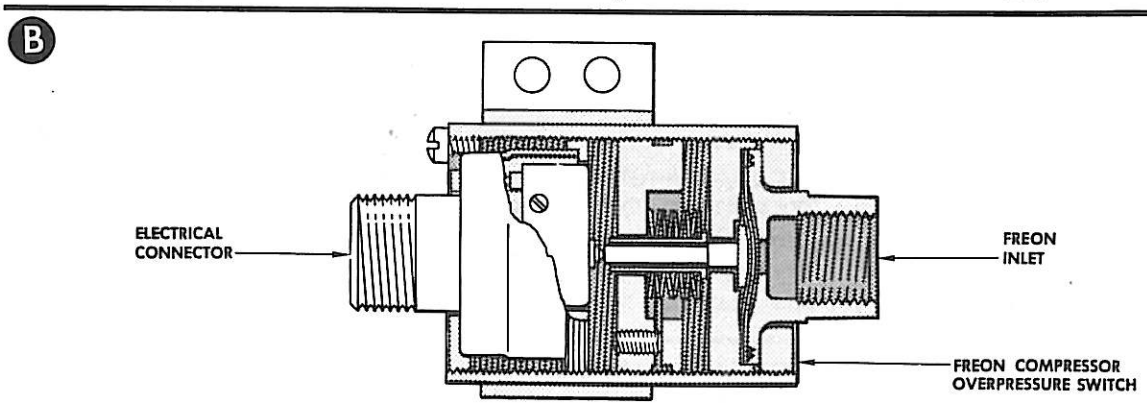
A. Description.

The Freon compressor discharge overpressure switch, shown on Figure 11A, is a three-inch, cylindrically-shaped, piston-actuated switch. The switch is mounted near the aft end of the Freon package just above the bellows control and sequencing device. A tube connects the switch port to the high pressure line at the upper aft end of the Freon condenser. A receptacle on the opposite end of the switch provides an electrical connection to the lockout relay.

B. Operation.

The overpressure switch senses Freon compressor discharge pressure at the Freon condenser inlet. When compressor discharge pressure exceeds a preset limit the piston moves the switch actuating pin, which closes the switch electrical contacts. The closed contacts route 28-volt dc power to energize the lockout relay. The lockout relay in turn deenergizes the Freon compressor motor relay to shut down the compressor. The overpressure switch resets automatically when compressor discharge pressure decreases below the switch pressure setting.





30.02.21.134

Compressor Overpressure Switch
Figure 11A

11B. Freon Compressor Motor Protector

A. Description.

The Freon compressor motor protector is a small box approximately two and one-half inches square by two inches high which houses three circuits; they are the current-overload circuit, loss-of-phase circuit, and an amplifier circuit to trip the Freon lockout relay.

The current-overload and loss-of-phase circuits actuate the amplifier circuit. Inputs to the protector are from the current transformer and neutral terminal of the Y-connected windings of the Freon compressor motor. The protector housing box contains an electrical connector, an adjustment screw, and two holes to accomodate mounting bolts to secure the protector to the Freon package aft frame.

B. Operation.

The Freon compressor motor protector provides current-overload and loss-of-phase protection for the Freon compressor motor. An amplifier circuit in the protector applies a dc voltage to trip the Freon lockout relay and shut down the Freon package should current overload or loss of phase occur.

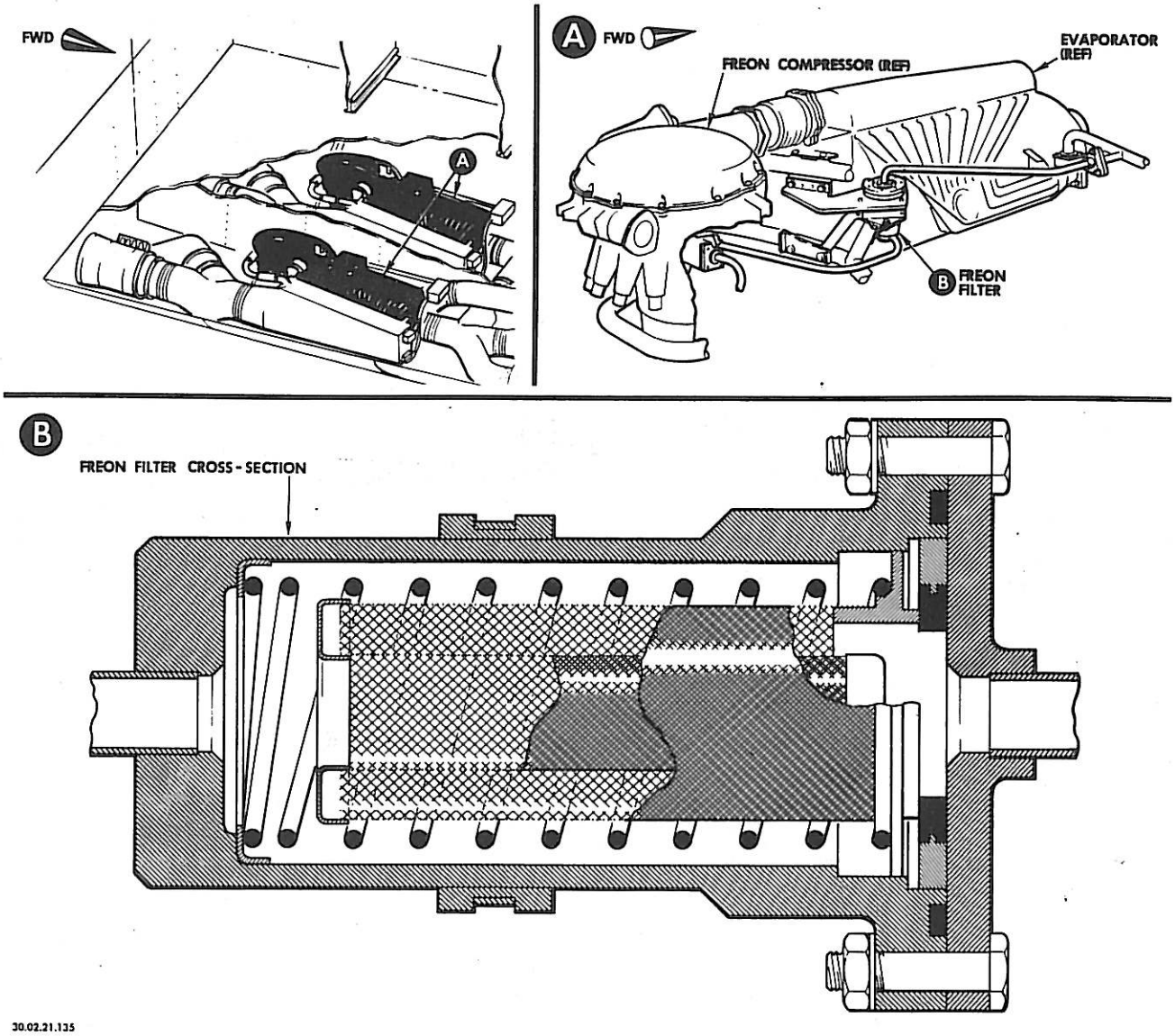
During normal current loads of the Freon compressor motor, normal current signals from the current transformer are blocked within the current-overload circuit of the protector. Should an overload of dangerous proportions occur within the compressor motor, increased current signals from the current transformer pass through blocking diodes of the protector current-overload circuit. The signal from the current-overload circuit actuates the amplifier circuit to trip the Freon lockout relay and shut down the Freon compressor package.

During normal phase-balance and momentary phase-unbalance of the compressor motor Y-windings, the signal from the neutral connection of the compressor motor is blocked within the loss-of-phase circuit. Should a prolonged phase-unbalance occur, such as loss of one phase in the compressor motor, increased signal voltage from the neutral connection passes through blocking diodes in the loss-of-phase circuit. The signal from the loss-of-phase circuit actuates the amplifier circuit to trip the Freon lockout relay and shut down the Freon compressor package.

11C. Freon Filter

A. Description.

The Freon filter, shown on Figure 11B, is cylindrically shaped and is located in the compressor motor cooling loop between the condenser and the compressor motor cooling expansion valve. The filter consists of a housing containing a can-shaped filter screen which is spring-loaded against a cap seal.


FWD
A
A
FWD
EVAPORATOR (REF)
FREON COMPRESSOR (REF)
B
FREON FILTER
B
FREON FILTER CROSS-SECTION
30.02.21.135

B. Operation.

Freon flowing from the condenser to the motor cooling expansion valve passes through the filter screen which removes any foreign matter from the Freon. Should the filter screen become clogged, the Freon will force the screen against its spring load, causing it to displace from the cap seal and allow the Freon to flow around the screen without filtration.

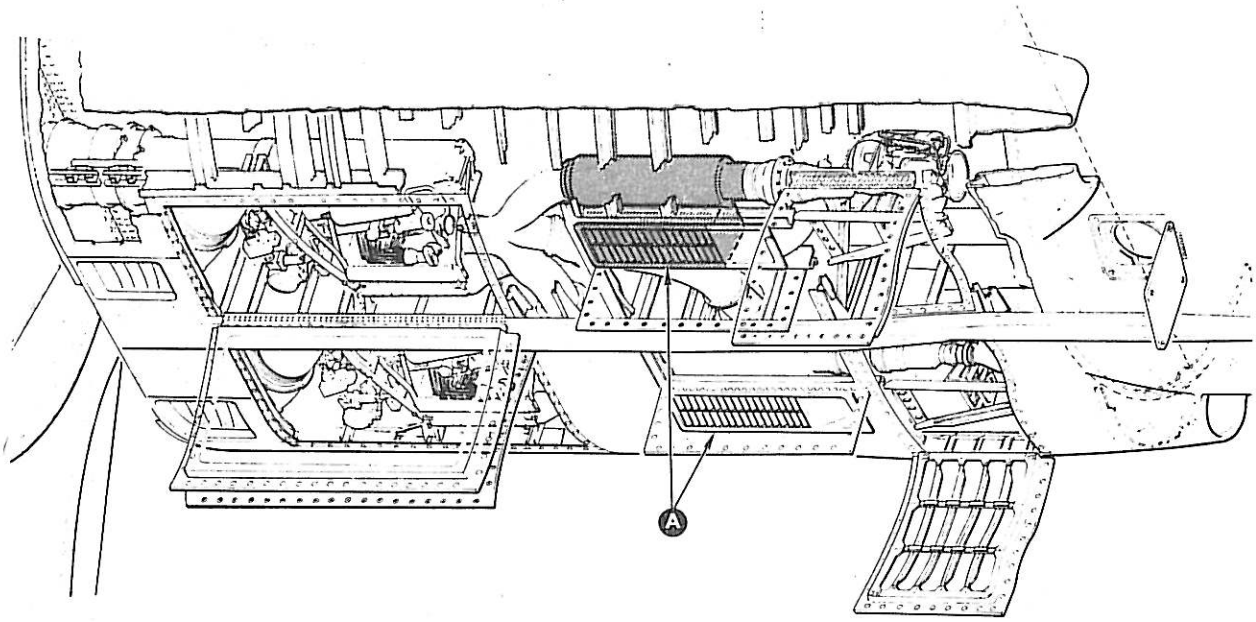
12. Air-to-Air Heat Exchanger

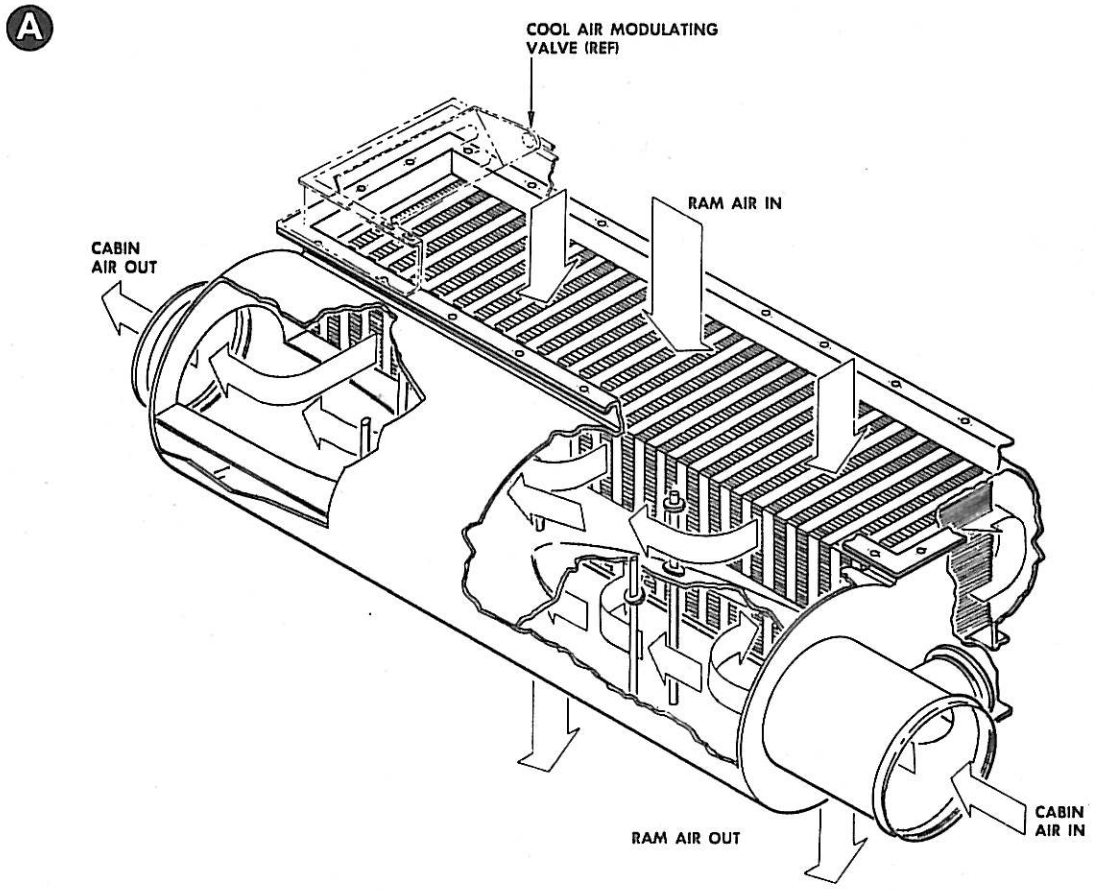
A. Description.

The heat exchanger, shown on Figure 12, is a rectangular box with a cylindrical duct attached along one side. Internally it contains a heat exchanger core of plate and fin design with a system of passageways connecting into the cylindrical duct on each side of a baffle. A second set of passageways connect the rectangular ram air inlet to the ram air outlet. The cylindrical duct contains a diagonal baffle secured by six rods through the cylinder. The heat exchanger cooling air modulating valve is connected to the ram air entrance of the heat exchanger. The ram air exit end of the heat exchanger is connected to the exit duct.

B. Operation.

Pressurized air from the turbocompressor flows in the inlet end of the cylindrical duct to the baffle which directs the air to the exchanger core. The air flows through the first level of the exchanger core then is directed back through the second level and into the cylindrical duct. Ram air flows into the top of the exchanger, passes through the exchanger core, and is discharged overboard from the bottom of the exchanger. Heat is transferred from the pressurized air to the ram air by conductance through the plates and fins of the core. The plates and fins are arranged to provide maximum conducting surfaces exposed to both air passageways.


A


A
COOL AIR MODULATING VALVE (REF)
RAM AIR IN
CABIN AIR OUT
RAM AIR OUT
CABIN AIR IN

22.35.21.228

13. Heat Exchanger Cool Air Modulating Valve

A. Description.

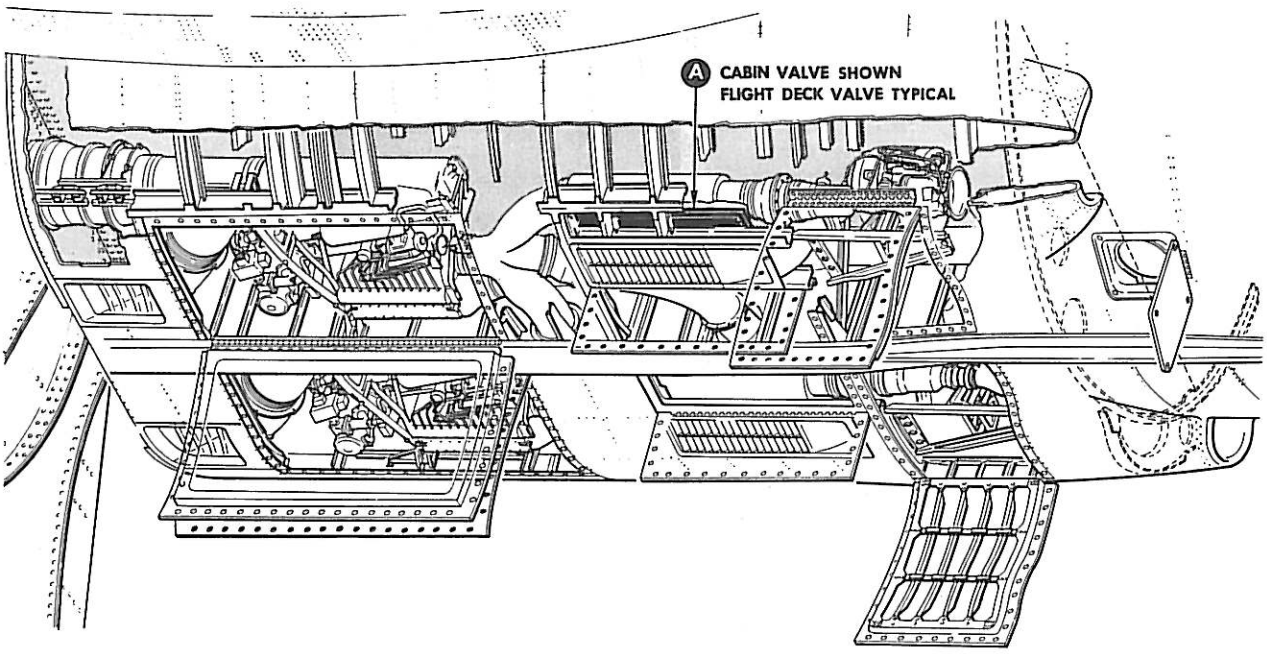
The cool air modulating valve, shown on Figure 13, is a louver type, electrically-actuated, rectangular valve that mounts over the heat exchanger ram air inlet. The valve has an electric actuator that contains a feedback potentiometer, an electric motor and reduction gear train. The actuator is splined to a drive lever that operates the valve shutters or louvers through a cam arrangement connected to the shutter linkage. Wiring harnesses connect the actuator to ground, electronic temperature control, temperature control AUTO-OFF-MAN switch, the 160 degree F thermal switch, and the manual temperature control MAN HOT-MAN COLD switch.

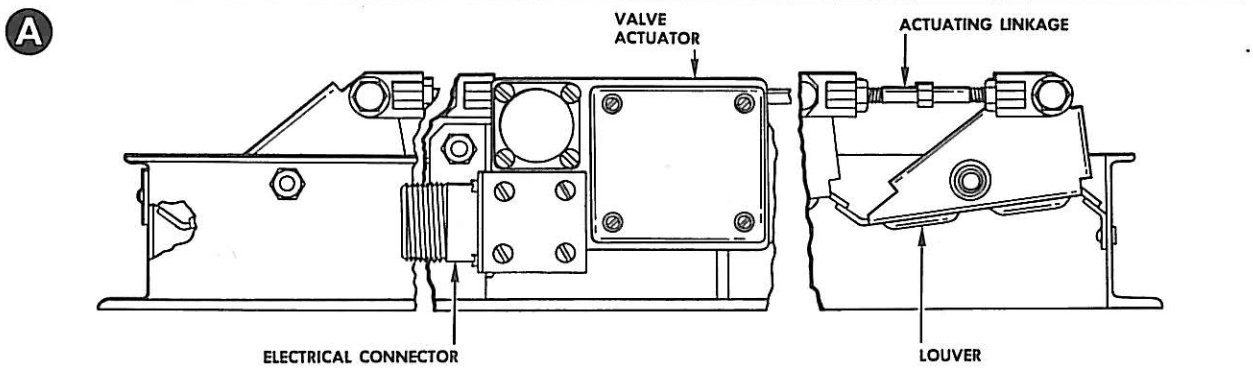
B. Operation.

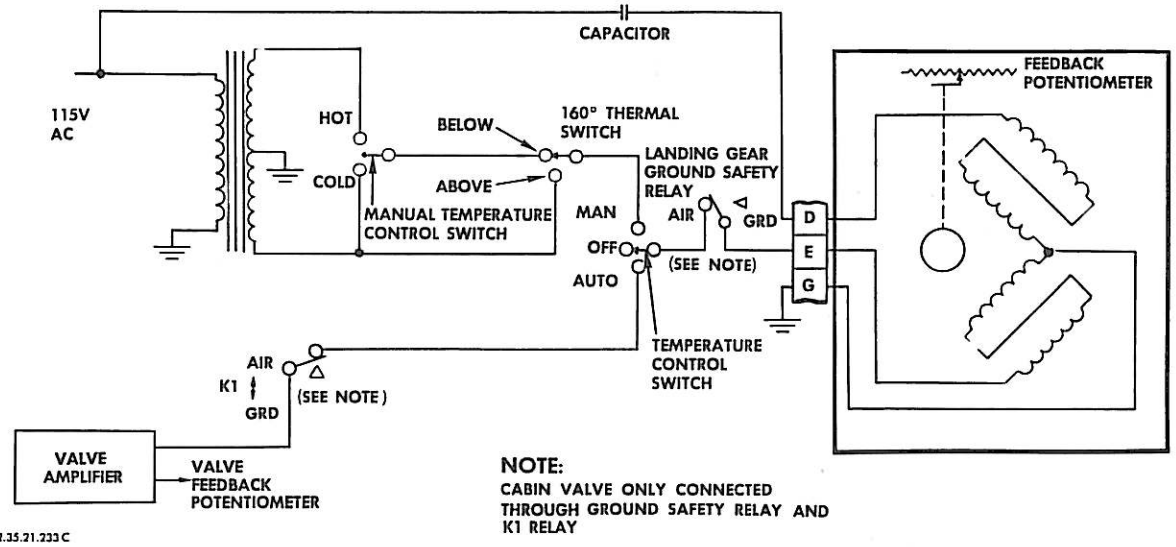
The cool air modulating valve regulates the ram air flow through the heat exchanger. The valve is inoperative during ground operation of the system but is subject to modulation when the airplane is airborne. The valve is automatically or manually controlled. The actuator motor is a servo motor with two phase windings. Reference voltage of 115-volt, ac power is capacitance coupled to one motor winding, and control voltage for valve modulation connects to the opposite winding from the amplifier output through closed contacts of the K1 relay (in cabin controller) and the temperature control AUTO-OFF-MAN switch (AUTO position).

Valve modulation is controlled by the temperature control system which causes control voltage from the amplifier to actuate the valve in accordance with matched potentiometer feedback and scheduled voltages.

When the temperature control AUTO-OFF-MAN switch is placed in the MAN position, the control voltage is shifted from the amplifier to 115-volt ac through the 160 degree F thermal switch "cold" contact and the manual temperature control MAN HOT-MAN COLD switch (in MAN HOT position). This switch arrangement closes the valve. If the 160 degree F thermal switch actuates or the manual temperature control MAN HOT-MAN COLD switch is placed in the MAN-COLD position, the valve will open by application of the 115-volt ac (phase shifted 180 degrees) to the control winding.


A CABIN VALVE SHOWN
FLIGHT DECK VALVE TYPICAL


A
VALVE ACTUATOR
ACTUATING LINKAGE
ELECTRICAL CONNECTOR
LOUVER


CAPACITOR
115V AC
HOT
COLD
BELOW
ABOVE
160° THERMAL SWITCH
MANUAL TEMPERATURE CONTROL SWITCH
LANDING GEAR GROUND SAFETY RELAY
AIR
GRD
MAN
OFF
AUTO
(SEE NOTE)
TEMPERATURE CONTROL SWITCH
FEEDBACK POTENTIOMETER
D
E
G
AIR
K1
GRD
(SEE NOTE)
VALVE AMPLIFIER
VALVE FEEDBACK POTENTIOMETER
NOTE:
CABIN VALVE ONLY CONNECTED THROUGH GROUND SAFETY RELAY AND K1 RELAY
22.35.21.233C

CONVAIR MODEL 30

MAINTENANCE MANUAL

TEMPORARY REVISION NO. 21-25.

Insert facing 21-3-1, Page 25, dated Nov. 15/62 (or subsequent).

The instructions in this temporary revision are applicable to airplanes not modified per Hamilton Standard Service Bulletin 21-24. For airplanes modified per Hamilton Standard Service Bulletin 21-24, use the information on Page 27.

Retain this temporary revision in your manual until applicable airplanes have been modified per noted service bulletin.

Page 25, In paragraph 14.B Operation, delete last portion of paragraph starting with "When one leg of the 115/200-volt....."

14. Recirculation Fan

A. Description.

The recirculation fan, shown on Figure 14, is an axial flow type fan with impellers on both inlet and outlet. The fan is powered by an induction motor containing a normally-open self-resetting thermal protective switch connected to a lockout relay on the fan housing. The fan motor contains a single-phase current protection circuit which protects the fan motor from damage due to a "failed" current limiter. This circuit is also connected to the lockout relay. Power is supplied through a fan motor relay which is controlled by 28-volt dc power through the RECIRCULATING BLOWER AUTO-OFF-MAN switch and switch contacts in the recirculation air control valve. The dc power is grounded through the lockout relay.

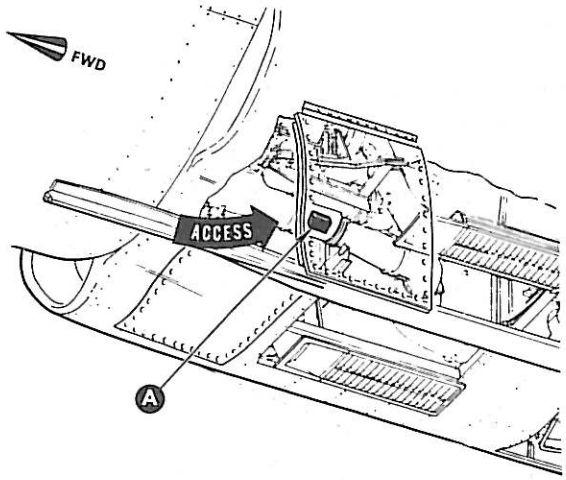
B. Operation.

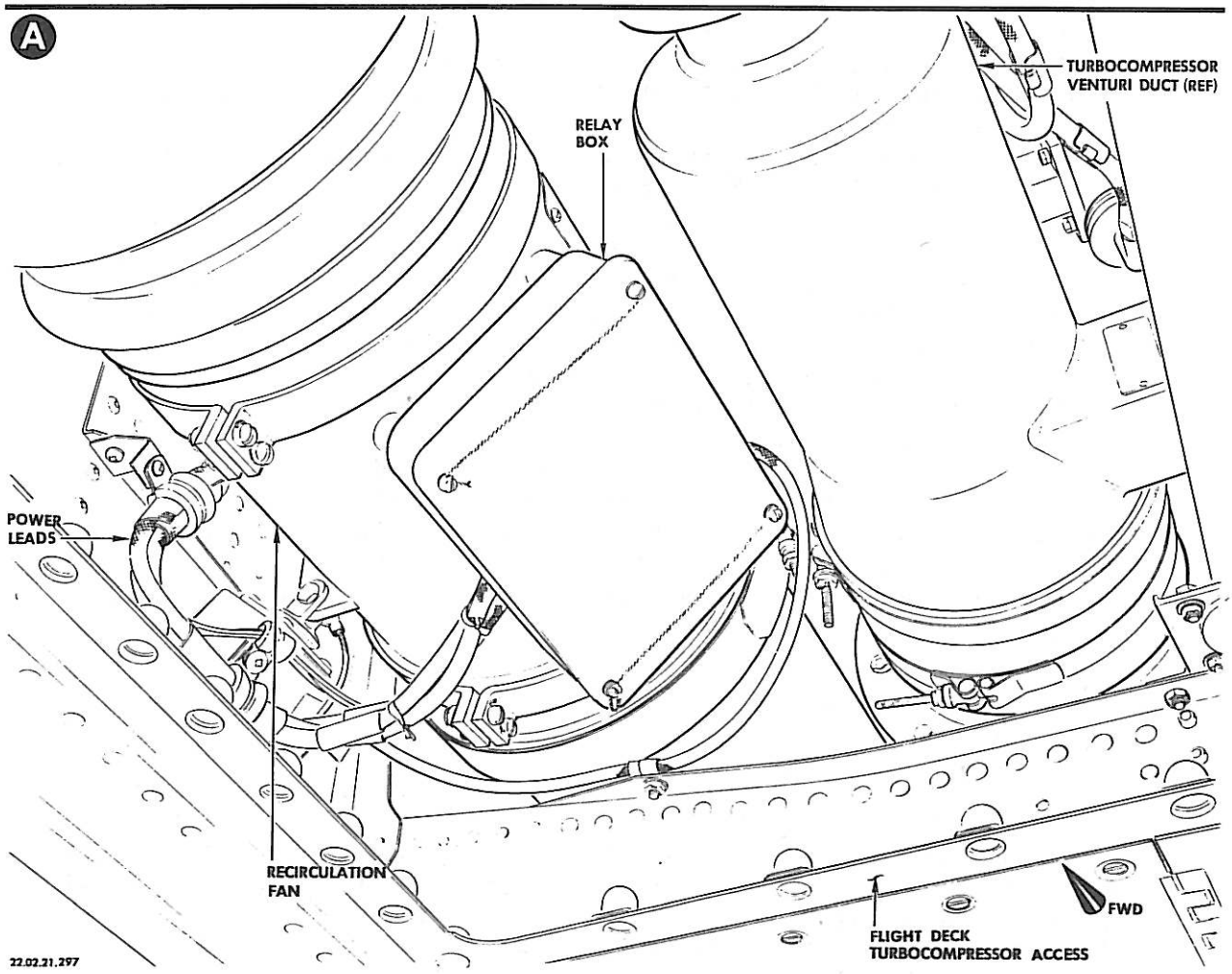
The recirculation fan, used primarily when the airplane is groundborne, provides a flow of air from the cabin and flight compartments to both Freon packages. The recirculation fan can also be used during flight in the event one turbocompressor fails. Airflow from the fan, when added to the airflow from the operating turbocompressor, will be sufficient to maintain system operation. Operation of the fan is controlled by the RECIRCULATING BLOWER AUTO-OFF-MAN switch and the lockout relay. When the switch is in the AUTO position, 28-volt dc power is supplied to energize the fan motor relay. The closed contacts of the relay provide 115/200 volt, three-phase, ac power to the "Y" connected windings. The energized solenoid of the fan motor relay is grounded through the lockout relay. If the motor overheats during fan operation, the thermal switch closes a circuit that energizes the lockout relay, de-energizing the motor relay by interrupting ground. The thermal switch resets automatically when the fan motor temperature returns to normal. When one leg of the 115/200-volt ac, three-phase voltage is lost, the potential voltage from the remaining two legs is rectified by a rectifying diode. This rectified voltage charges a capacitor until the voltage buildup reaches approximately 20 to 24 volts. When this voltage is reached a four layer diode, acting as a switch, will break down and complete the circuit. The capacitor then discharges and applies its voltage through the diode to energize the lockout relay in the same manner as the thermal overload switch. The fan is then inoperative until the lockout relay has been manually reset.

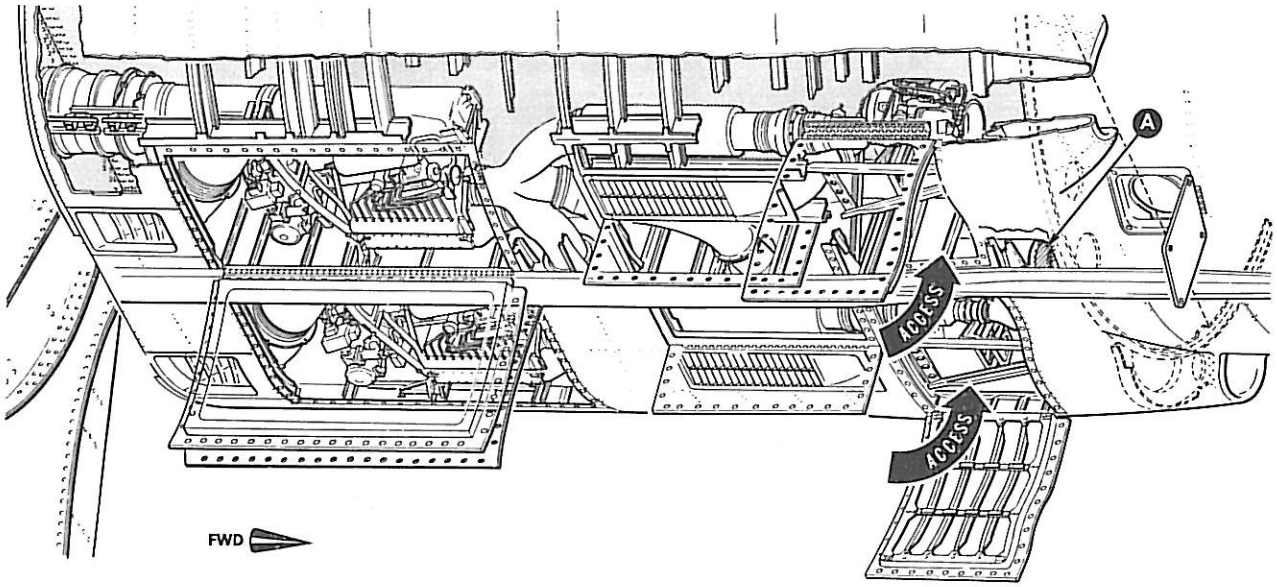
15. Recirculation Air Control Valve

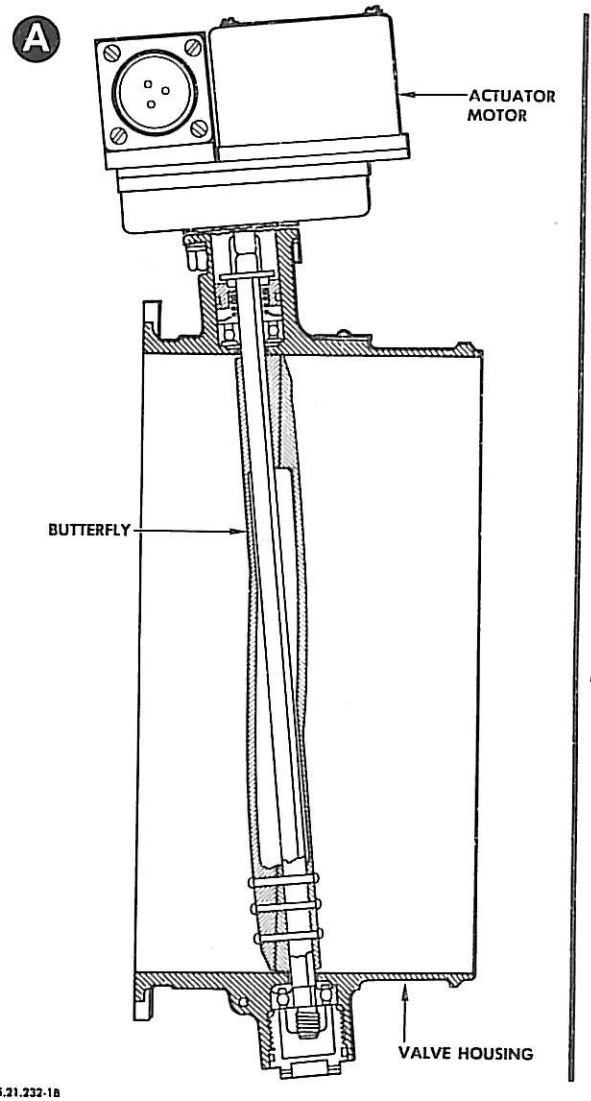
A. Description.

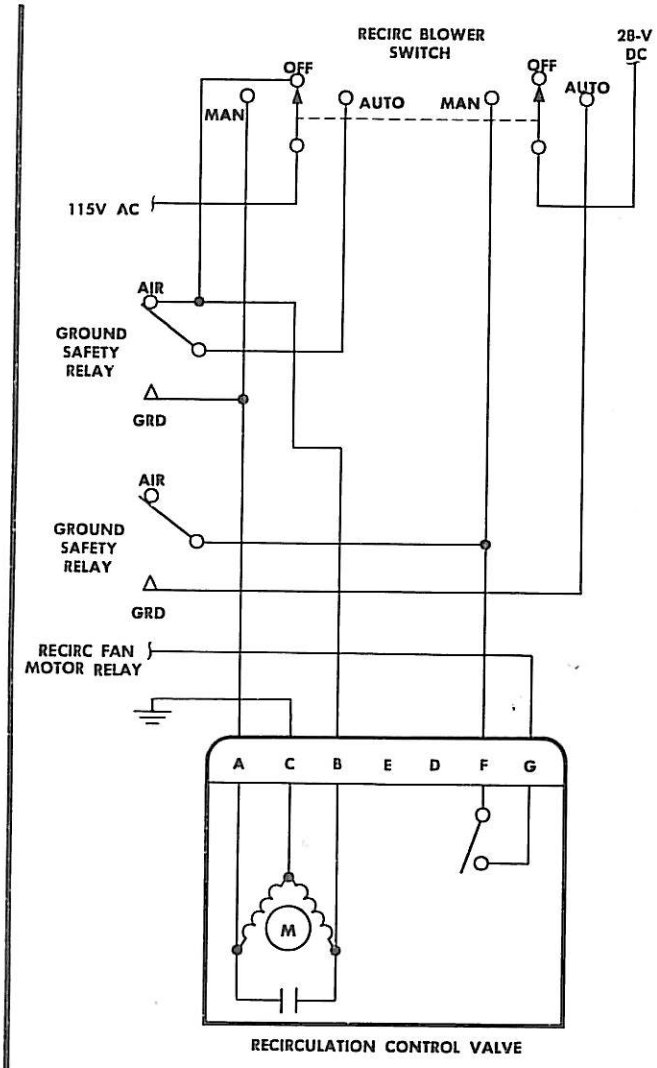
The recirculation control valve, shown on Figure 15, is an eight-inch electrically actuated butterfly valve. The actuating motor is connected through a gear reduction train and splined shaft to the butterfly valve. The actuator housing also contains an open position limit switch and a phase shifting capacitor. Airplane wiring connects the valve actuator to the cabin temperature control, RECIRCULATING BLOWER AUTO-OFF-MAN switch, recirculation fan motor relay, and landing gear ground safety relay.


FWD
ACCESS
A


A
TURBOCOMPRESSOR
VENTURI DUCT (REF)
RELAY
BOX
POWER
LEADS
RECIRCULATION
FAN
FWD
FLIGHT DECK
TURBOCOMPRESSOR ACCESS
22.02.21.297

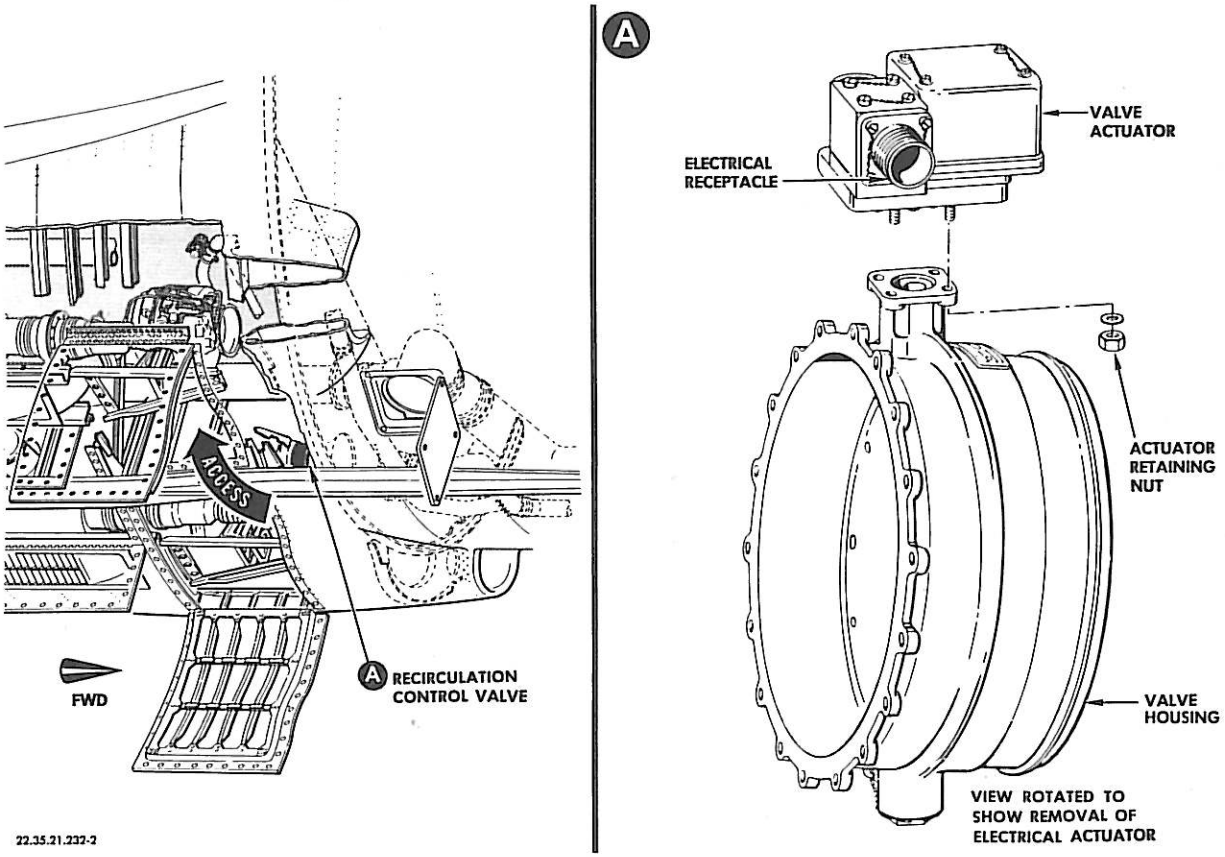






22.35.21.232-18

Recirculation Air Control Valve
Figure 15 (Sheet 1 of 2)


ACCESS
FWD
A RECIRCULATION CONTROL VALVE
22.35.21.232-2
A
VALVE ACTUATOR
ELECTRICAL RECEPTACLE
ACTUATOR RETAINING NUT
VALVE HOUSING
VIEW ROTATED TO SHOW REMOVAL OF ELECTRICAL ACTUATOR

B. Operation.

The recirculation control valve is used primarily during ground operations to provide adequate ventilation in the cabin and flight compartments. The valve can also be opened during flight when the recirculation fan is used to supplement the air conditioning system when using only one turbocompressor. It is used in conjunction with the recirculation fan to maintain a comfortable temperature. When the recirculation fan is operated in flight, the recirculation control valve moves to the full open position.

When the recirculation control valve is open, it admits cabin air from the aft end of the forward cargo compartment to the recirculation fan. The output from the fan is directed through the normal air conditioning equipment and back into the cabin and flight compartments.

16. Recirculation Air Check Valves

A. Description.

Each recirculation air check valve consists of a metal housing divided into four sections. Each section contains a flapper valve held in the closed position by a spring. One end of the valve is flanged, and the opposite end is beaded to prevent installing the valve incorrectly. The recirculation air check valves, the conditioned air check valves and turbocompressor check valves are identical.

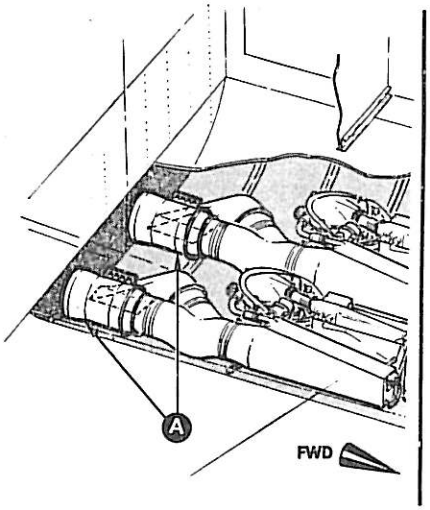
B. Operation.

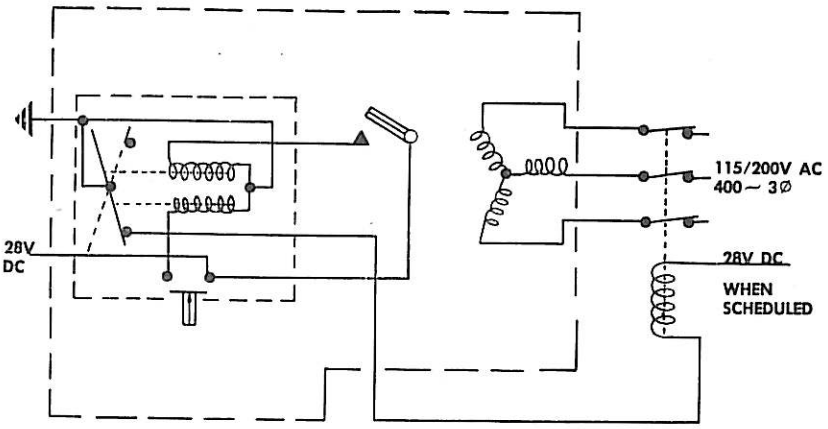
The recirculation air check valves permit air to flow from the recirculation fan, but close to prevent a reverse flow of air from the turbocompressors to the fan. The check valves also prevent a crossover flow of air between the cabin and flight deck systems in the event one turbocompressor fails or is shut down during flight. Engine bleed air is also prevented from entering the fan housing when the emergency pressurization system is operating.

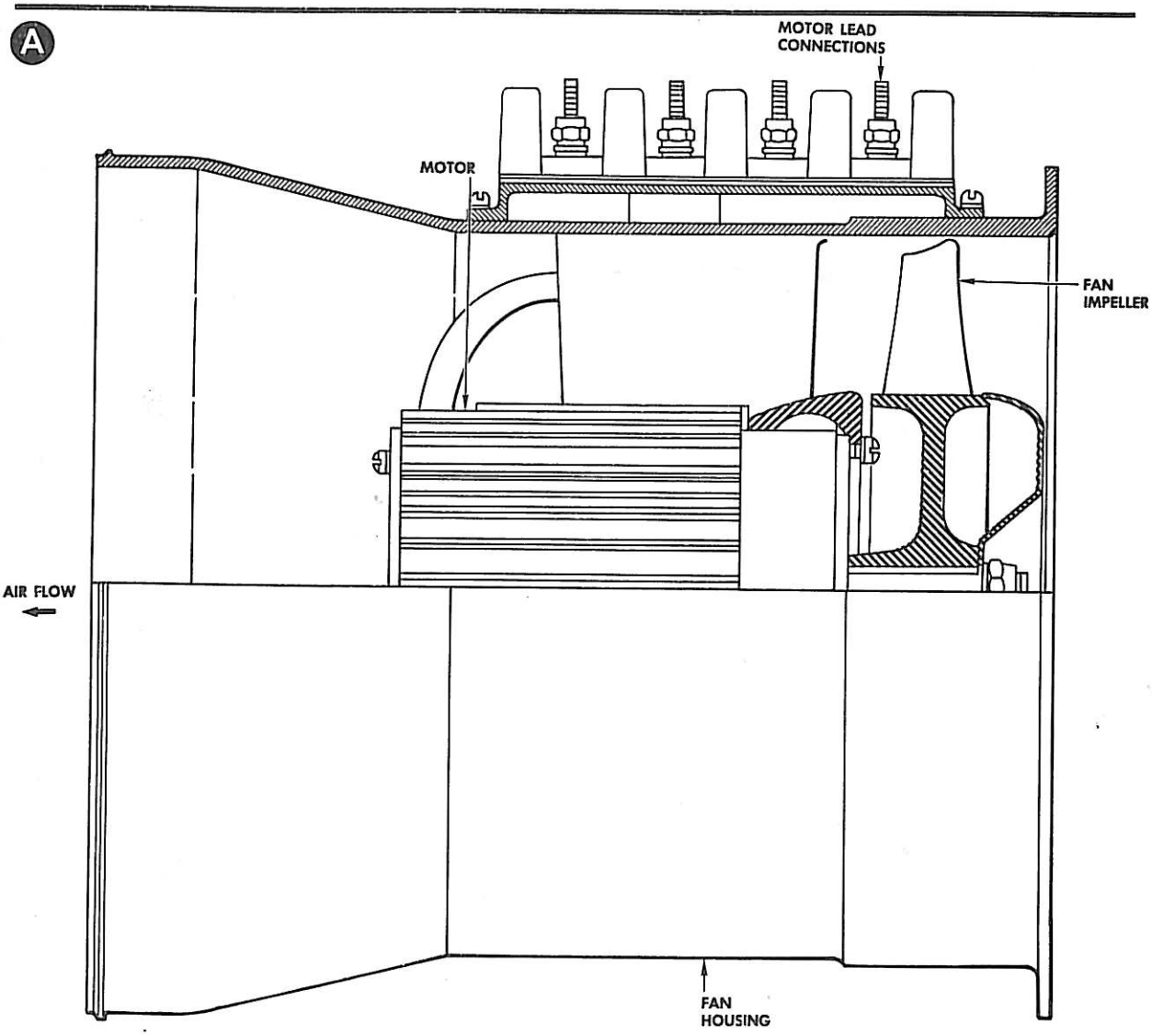
17. Condenser Fan

A. Description.

The condenser fan, shown on Figure 16, is a ten-inch axial flow type fan, powered by an induction motor. The motor contains a normally open self-resetting thermal protective switch that is connected to a lockout relay on the fan housing. The fan is connected to electrical power through the condenser fan motor relay. The motor relay is grounded through the lockout relay and connects to 28-volt dc power through the condenser ground cooling air shutoff valve position switch, condenser cooling control relay, sequencing device, FREON COMPRESSOR FLT DECK OFF-BOTH ON-CABIN OFF control switch, and the Freon compressor MASTER ON-OFF switch.


A
FWD


28V
DC
115/200V AC
400 ~ 3Ø
28V DC
WHEN
SCHEDULED


A
MOTOR LEAD
CONNECTIONS
MOTOR
FAN
IMPELLER
AIR FLOW
FAN
HOUSING

22.30.21.054A

B. Operation.

The condenser fan induces an airflow through the Freon condenser when the airplane is on the ground, or at low airspeeds when ram air cooling is insufficient. Operation at low airspeeds is controlled through a pressure switch and the condenser cooling control relays. When cooling is scheduled and the condenser ground cooling air shutoff valve is open, 28-volt dc power energizes the fan motor relay. The closed contacts of the relay provide 115/200-volt, 3 phase, ac power to the "Y" connected fan motor windings. If the fan motor overheats during operation, a thermal switch closes a circuit that trips the lockout relay, thus de-energizing the motor relay by interrupting ground. The fan is then inoperative until the lockout relay has been manually reset by means of a push button on the fan housing. The thermal switch resets itself automatically when the fan motor temperature returns to normal.

18. Condenser Cooling Air Pressure Switch

A. Description.

The condenser cooling air pressure switch is a single pole, double throw, pressure operated, snap-action type switch. The switch and pressure unit are contained within a cylindrical housing which is approximately three inches in diameter and one and one half inches long. The cylinder contains a series of ram air pressure breather holes and an electrical receptacle on one end, and an ambient air pressure sensing port on the opposite end. The pressure switch is located outboard of the flight deck Freon package and senses ram air pressure in the air conditioning compartment.

B. Operation.

When the airplane is in cruising flight, and ram air maintains compartment pressure above 0.50 (±0.07) psig, there is sufficient condenser cooling from ram air flow. However, when ram air pressure drops below approximately 0.5 psig, such as during a landing approach, the condenser cooling air pressure switch actuates. When the switch actuates it routes 28-volt dc power to energize the right and left-hand condenser cooling control relays. The left-hand relay, when energized, routes 115-volt ac power to close the condenser cooling air modulating valve, open the condenser ground cooling shutoff valve and start the condenser fan for the flight compartment air conditioning system. The right-hand relay performs the same function for the cabin air conditioning system. Thus, a constant source of cooling air, either from ram air flow or from fan induced airflow, is provided to cool the Freon condenser when cooling is scheduled for the air conditioning system.

19. Condenser Cooling Air Modulating Valve

A. Description.

The cooling air modulating valve, shown on Figure 17, is a nine-inch electrically-actuated butterfly valve. The valve has an actuator that contains an electric motor and gear train which is splined to the butterfly valve. A butterfly valve disc and a center flapper are mounted on a common shaft. The actuator is electrically connected through the condenser cooling control relay to the Freon compressor motor relay and the condenser minimum temperature control.

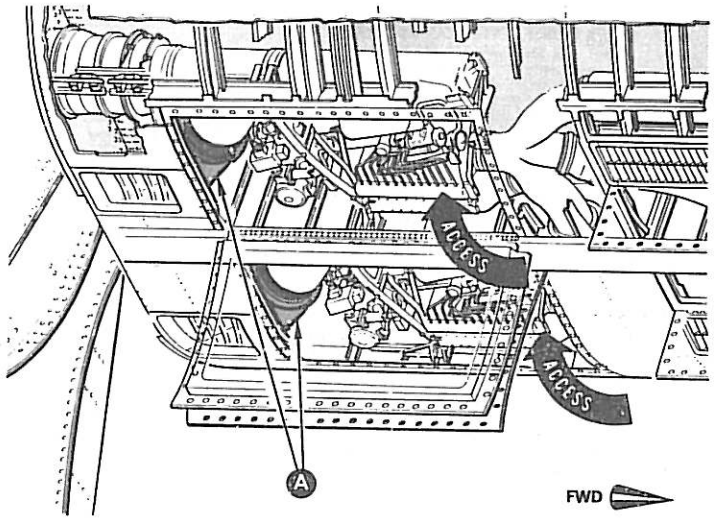
B. Operation.

Ram air discharge from the Freon condenser during cruising flight is controlled by modulating this valve. At low airspeeds a pressure switch actuates to close the cool air modulating valve, open the ground cooling air shutoff valve, and start the condenser fan. Modulation signals originate in the condenser minimum temperature control. The actuator electric motor is a servo motor with two phase windings. Motor rotation is caused by a phase difference in voltage applied to the motor windings. Reference voltage is 115-volt, ac power from the condenser temperature control and is capacitance coupled to one winding of the valve actuator at all times. Control voltage for valve modulation connects to the opposite winding from the condenser minimum temperature control amplifier through closed contacts of the Freon compressor motor relay and condenser cooling control relay (in airborne position). If the Freon compressor is turned off or ram air pressure falls below a predetermined minimum, 115-volts ac power is supplied to the control winding to close the valve. Thus, valve modulation is scheduled only in flight and only when cooling is scheduled provided that the temperature of the condenser discharge air is between 65 degrees F (18.3 degrees C) and 85 degrees F (29.4 degrees C). The valve will start closing when the condenser discharge air temperature reaches 65 degrees F, and will start opening when the air temperature reaches 85 degrees F.

20. Condenser Ground Cooling Air Shutoff Valve

A. Description.

The condenser cooling air shutoff valve is a nine-inch electrically actuated butterfly valve and is illustrated on Figure 18. The valve has an electrical actuator that contains a position switch, electric motor, and gear train. The actuator is splined to the butterfly valve. Wiring harnesses connect the actuator to 115-volt ac power through the condenser cooling control relay, to the condenser fan motor relay, sequencing device and control switches.



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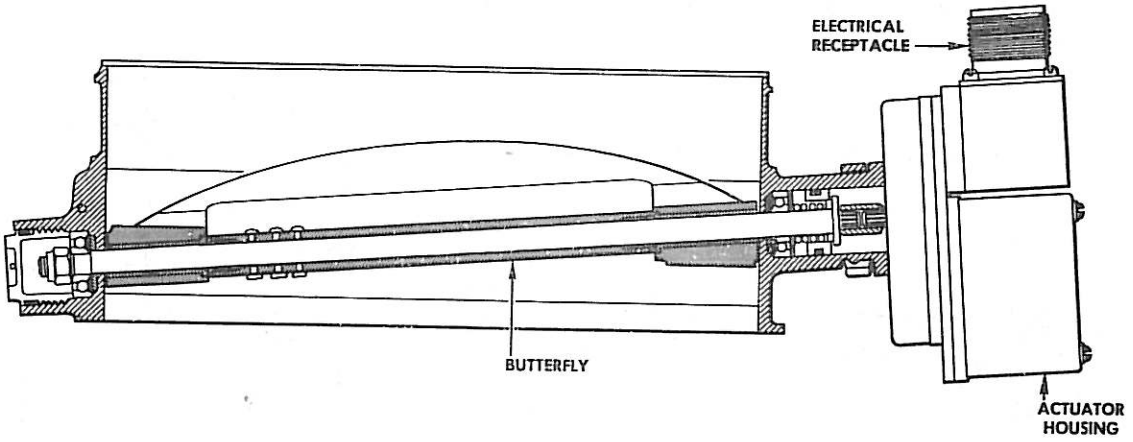
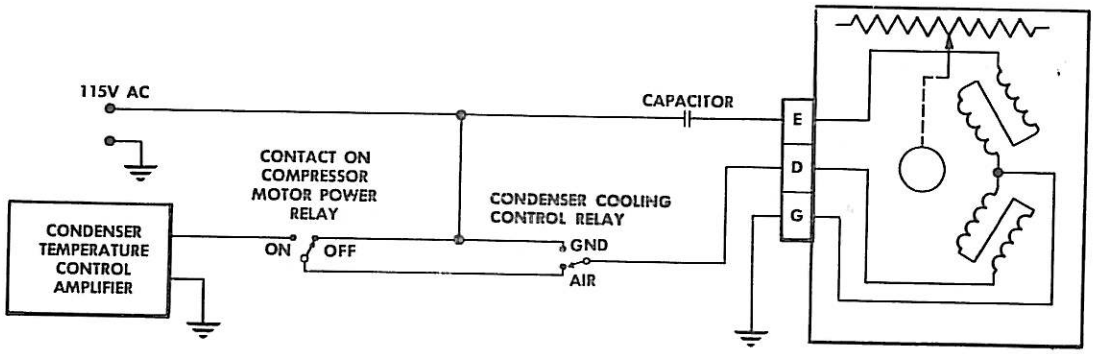
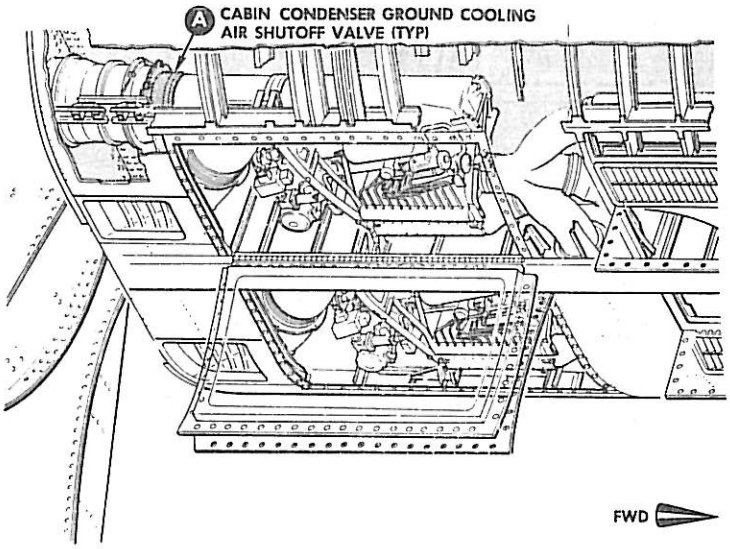




22.35.21.2258



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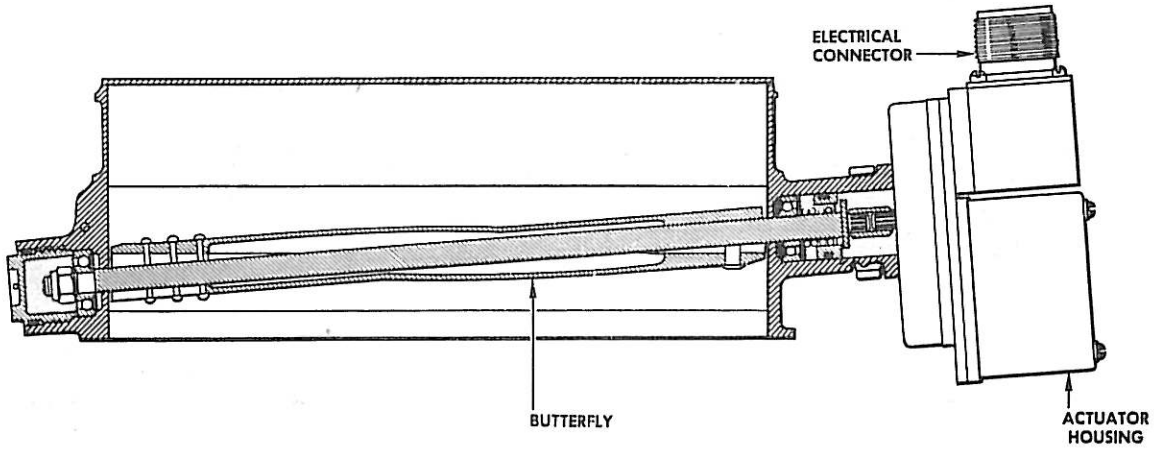
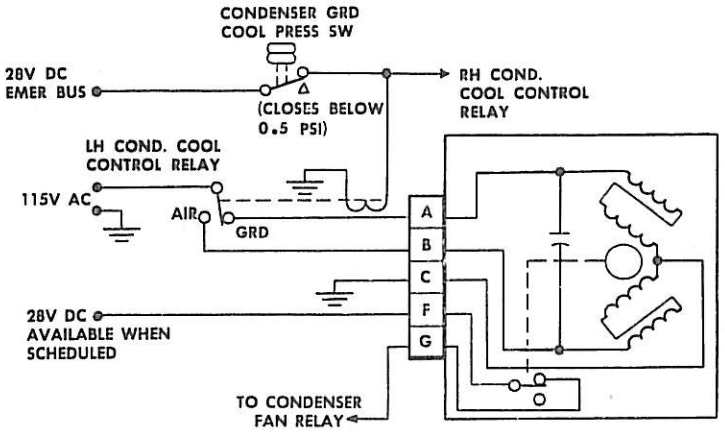




22.35.21.234 C

Condenser Ground Cooling Air Shutoff Valve
Figure 18

B. Operation.

The condenser cooling air shutoff valve controls the airflow through the Freon condenser during ground operation, or at low airspeeds when the condenser cooling air pressure switch is actuated. A limit switch closes when the valve reaches the full open position and completes a circuit to the condenser fan motor relay to operate the condenser fan. The actuator motor is a servo motor with a two-phase winding. Motor rotation is caused by the difference in phase established between the windings by the capacitor.

During ground operation, 115-volt ac power is applied through the condenser cooling control relay to one winding, opening the valve. If the airplane is airborne and ram air pressure in the plenum changer is sufficient to prevent the condenser pressure switch from actuating, the relay removes the power supplied to the "open" winding and applies this power to the "close" winding, closing the valve. During ground operation of the Freon package, the airflow through the condenser is induced by the condenser fan; hence, the signal to trip the condenser fan motor relay "on" is provided by the valve position switch. Thus, when the valve opens, the fan starts and cooling air is drawn through the condenser, valve, fan, and is discharged into the landing gear wheel wells.

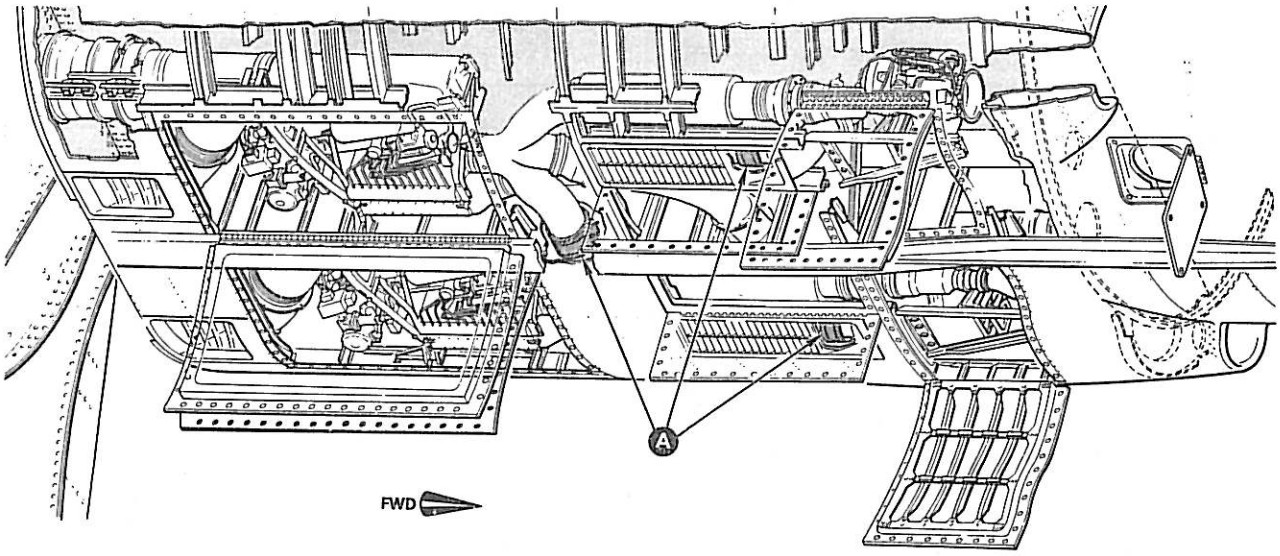
21. Conditioned Air Emergency and Crossover Shutoff Valves

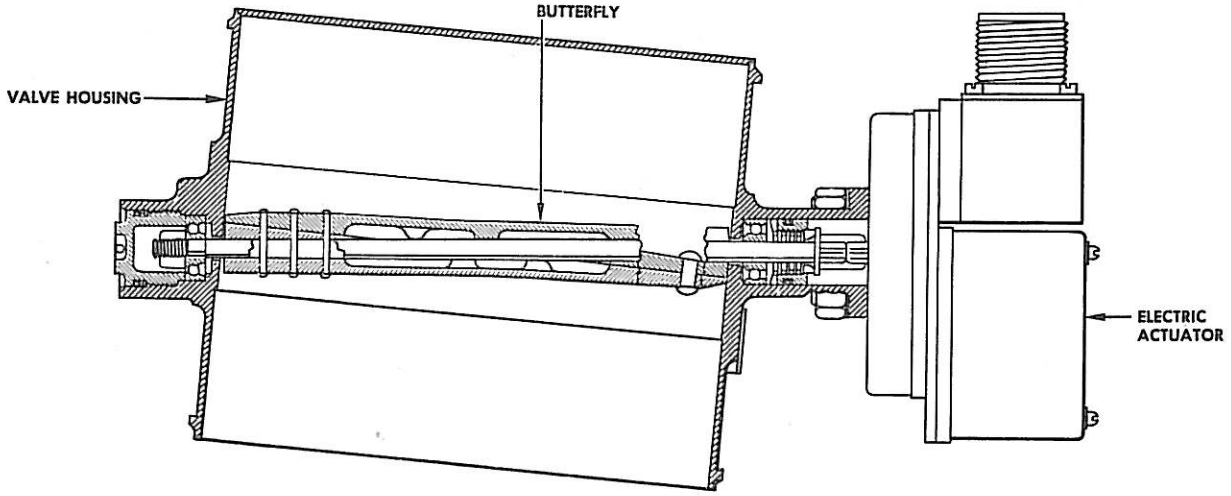
A. Description.

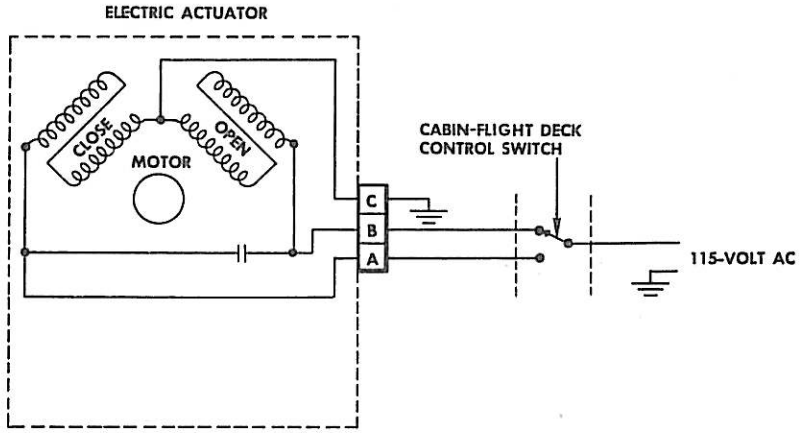
The conditioned air emergency and crossover shutoff valves, shown on Figure 19, are six inch electrically actuated butterfly valves. The electric actuators contain a capacitor and a motor. Airplane wiring connects the actuator to the FREON COMPRESSOR FLT DECK OFF-BOTH ON-CABIN OFF control switch on the flight engineer's control panel.

B. Operation.

The conditioned air emergency shutoff valve remains open during normal operation of the air conditioning and pressurization system. If it becomes necessary to shut down one of the Freon packages, the corresponding conditioned air emergency shutoff valve is automatically closed. Since the conditioned air emergency shutoff valve is electrically interconnected with the Freon compressor and crossover shutoff valve, the two valves will route the output of both turbocompressor packages (or emergency pressure sources) through the single operating Freon package. This is accomplished by opening the crossover shutoff valve when either the cabin or the flight compartment conditioned air emergency shutoff valve is closed. All of these functions are controlled by a single three-position switch labeled FLT DECK OFF-BOTH ON-CABIN OFF. When the switch is in the BOTH ON position, both Freon packages will operate, both conditioned air emergency shutoff valves will be open, and the crossover shutoff valve will be closed. Moving the switch to the CABIN OFF position will shut down the cabin Freon package, close the cabin conditioned air emergency shutoff valve, and open







22-35-21-230A

Conditioned Air Emergency and Crossover Shutoff Valves
Figure 19

the crossover shutoff valve. This will route the output of both turbocompressors through the flight compartment Freon package for cooling. In a similar manner, switching to the FLT DECK OFF position will route all pressurized air through the cabin Freon package.

22. Conditioned Air Check Valve

A. Description.

The conditioned air check valves, shown on Figure 20, are identical to the recirculation air check valves and the turbocompressor check valves. Refer to Recirculation Air Check Valves for a description of the valves.

B. Operation.

The conditioned air check valves permit airflow in one direction only. The check valves are installed between the air conditioning and pressurization system and the pressurized compartments to prevent the loss of pressure if it becomes necessary to shut down one side of the pressurization system. Without the check valve, cabin pressurization might be lost through reverse flow in the air distribution system.

23. Ram Air Shutoff Valve

A. Description.

The ram air shutoff valves, shown on Figure 21, each contain a hinged gate and an electric actuator and drive arm. The actuator contains a two-phase electric motor, a gear train, and a capacitor. Wiring connects the actuator to ground and to the RAM AIR SOURCE switch on the flight engineer's control panel. The valves connect to the conditioned air supply ducts.

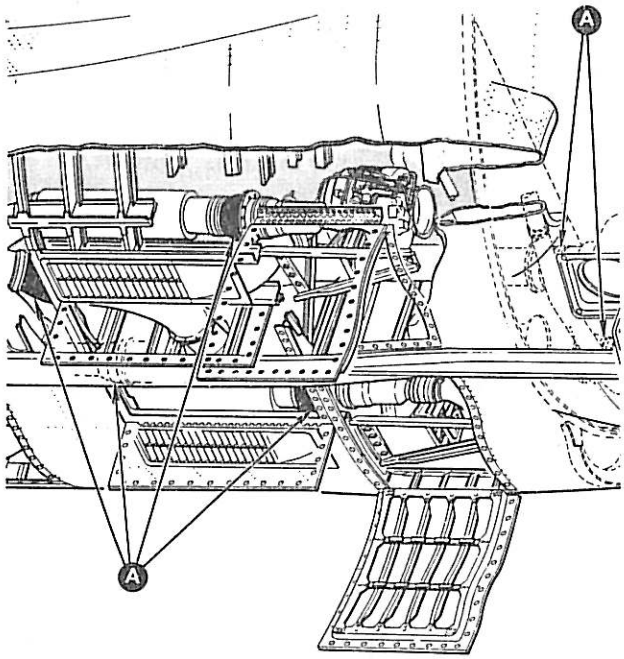
B. Operation.

The valves provide an alternate means of supplying fresh air for cabin ventilation at altitudes below those requiring pressurization. The valves are opened only in the event both turbocompressors fail. Placing the RAM AIR SOURCE switches in the OPEN position applies 115-volt, ac power to the "open" winding of each valve actuator motor. Motor rotation, caused by the difference in phase established by the capacitor between the motor windings, rotates the actuator drive arm away from the hinged gate. The gate will open only when ram air pressure exceeds cabin pressure.

24. Turbocompressor Check Valve

A. Description.

The turbocompressor check valves, shown on Figure 20, are identical to the recirculation air check valves and the conditioned air check valves. Refer to Recirculation Air Check Valves for a description of these valves.



22.35.21.246B

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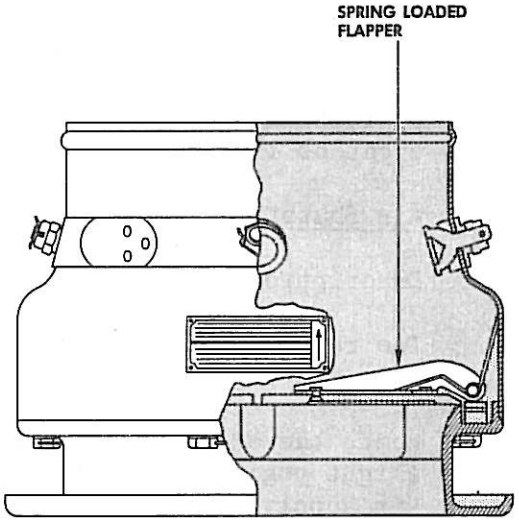
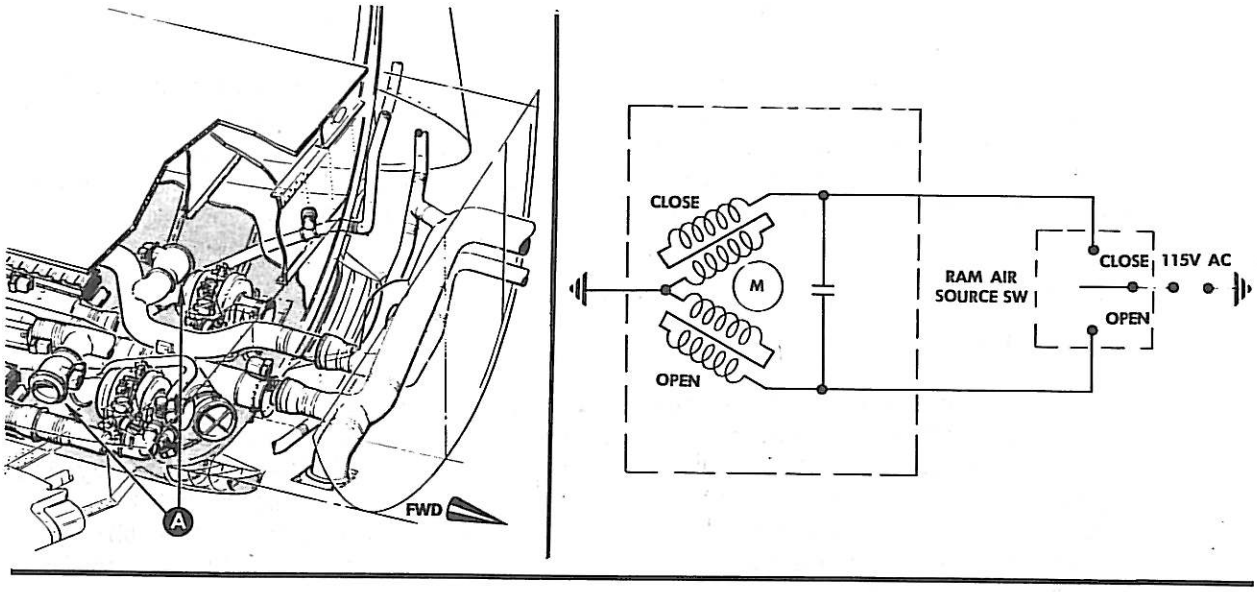
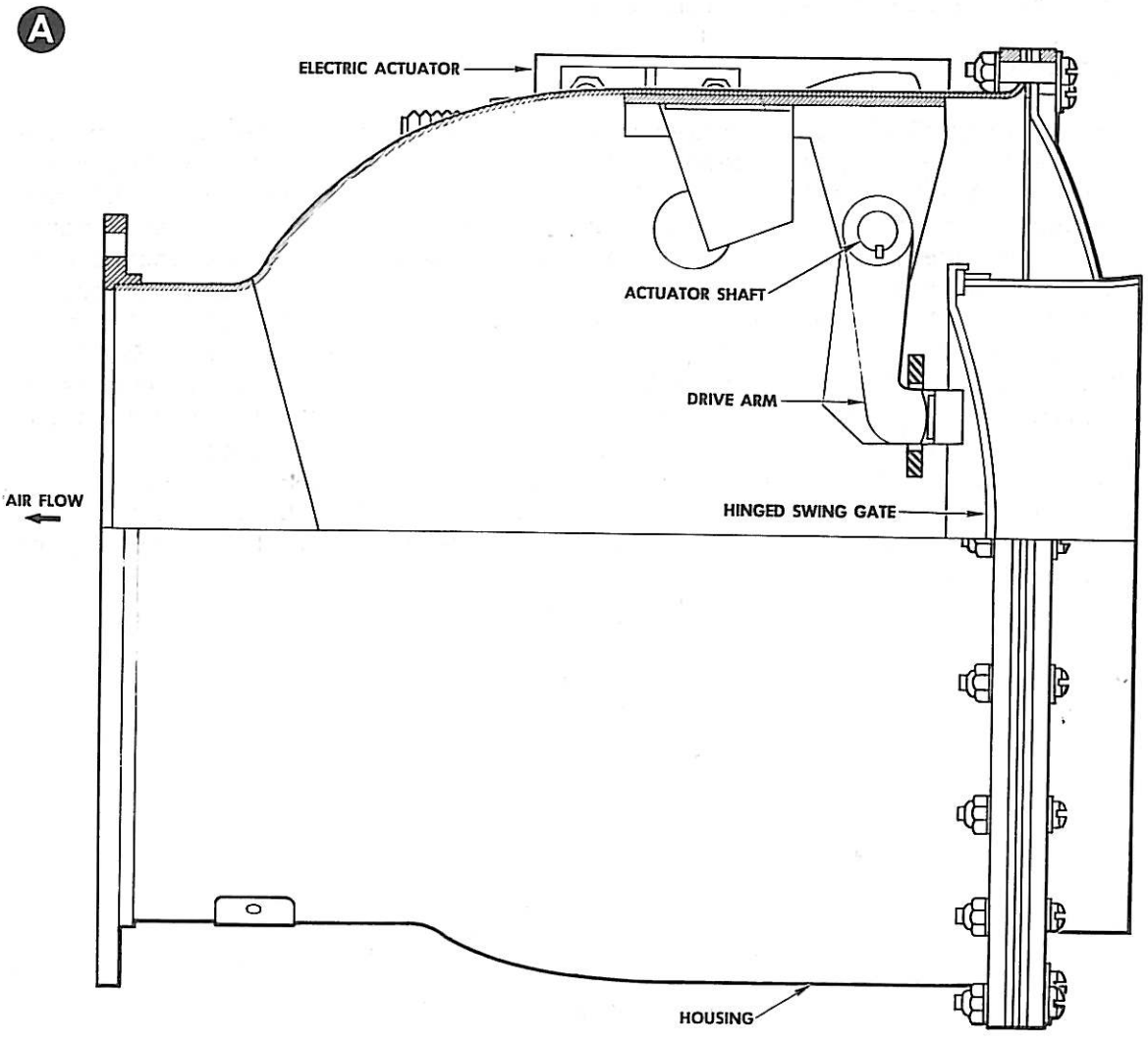


CONDITIONED AIR, RECIRCULATION AIR, OR
TURBO COMPRESSOR CHECK VALVE


A
FWD
CLOSE
M
OPEN
RAM AIR SOURCE SW
CLOSE
115V AC
OPEN


A
ELECTRIC ACTUATOR
ACTUATOR SHAFT
DRIVE ARM
AIR FLOW
HINGED SWING GATE
HOUSING

22.30.21.015B

B. Operation.

The check valves permit a free flow of air from the turbocompressors, but are held closed to prevent reverse airflow from an operating turbocompressor entering an inoperative turbocompressor. The check valves also prevent the loss of engine bleed air through the turbocompressors when the emergency pressurization system is operating.

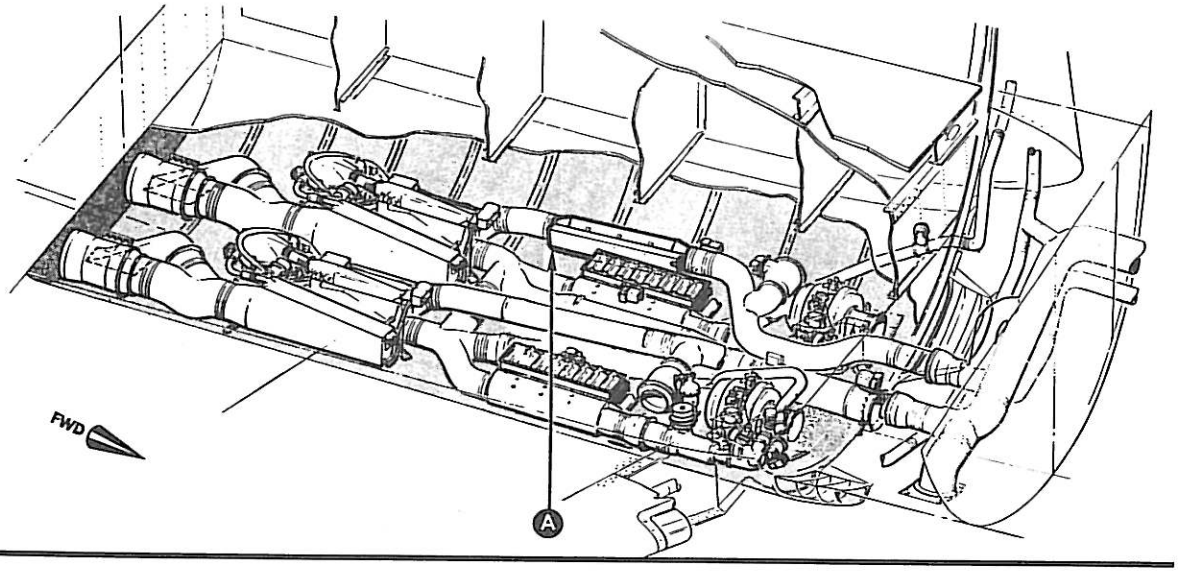
25. Flight Deck Electric Heater

A. Description.

The flight deck electric heater, shown on Figure 22, is an expanded section of ducting containing seven heating elements and an overheat switch. The heater terminals are connected to 115/200-volt, 400-cycle, 3 phase, ac power through the heater relays. The overheat switch, consisting of three normally closed contacts in series around the three phases of the first heater element, connects the relay coil to ground through the recirculation fan motor relay.

B. Operation.

The heating elements are relay-energized in seven increments to provide modulating heating from zero to full capacity when heating of the recirculated air is scheduled. When heating is scheduled cams within the sequencing device rotate and actuate a series of switches. Each switch as it actuates in turn applies 28-volt dc power from closed contacts of the landing gear ground safety relay (airplane on the ground) through the FREON COMPRESSOR FLT DECK OFF-CABIN ON-BOTH OFF control switch to the coils of respective (1 through 7) heater element relays. When low flow requirements, coupled with high scheduled heating, cause excessive element heating (to 350 degrees F) or if the recirculation fan is turned off, the duct heater will be inoperative since actuating either the thermal switch or fan motor relay will interrupt the 28-volt dc relay ground, thus removing power from the elements. The thermal protective switch will automatically reset when temperatures fall below 350 degrees F (177 degrees C).



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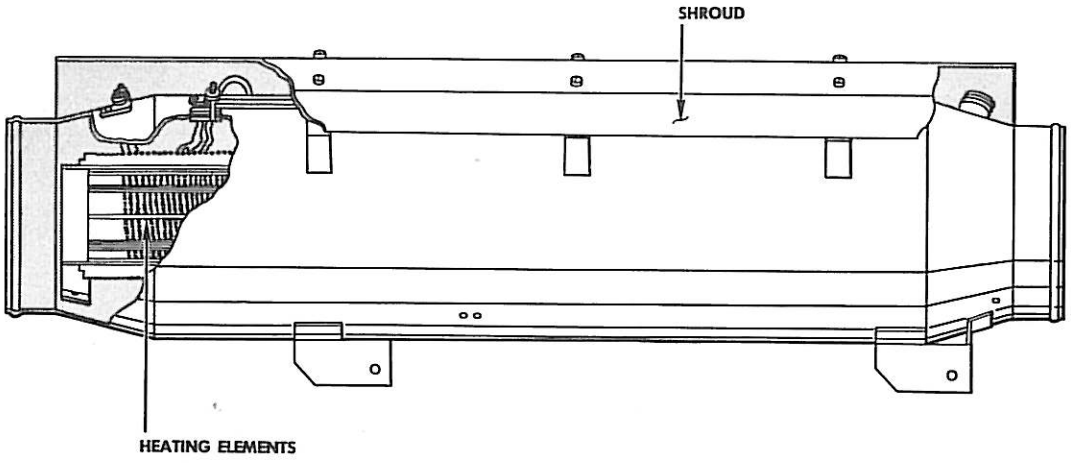
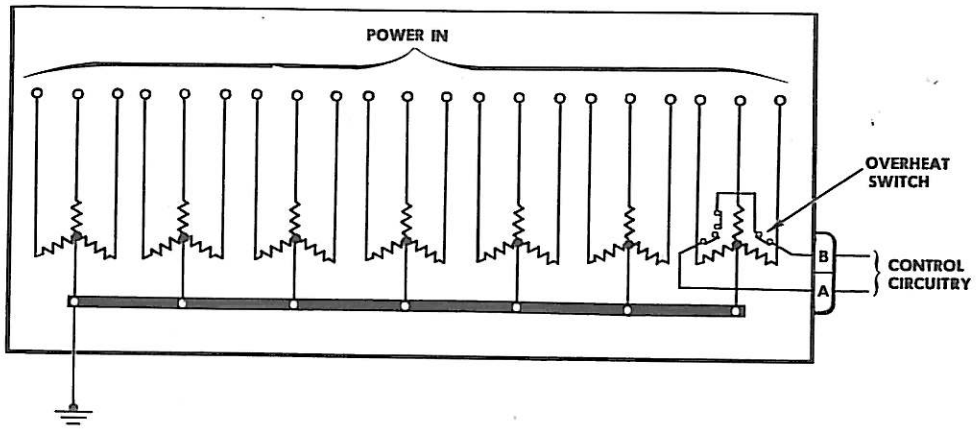




22.35.21.236 B

CONVAIR MODEL 30

MAINTENANCE MANUAL

TEMPORARY REVISION NO. 21-26.

Insert facing 21-3-1, Page 101, dated Nov. 15/62 (or subsequent).

The instructions in this temporary revision are applicable to airplanes not modified per Hamilton Standard Service Bulletin 21-19. For airplanes modified per Hamilton Standard Service Bulletin 21-19, use the information on Page 101.

Retain this temporary revision in your manual until applicable airplanes have been modified per noted service bulletin.

Page 101, third sentence under step 1.A., ISOLATION PROCEDURE AND CORRECTION, should read "If gage indicates below "0"....."

FREON PACKAGE - TROUBLE SHOOTING

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
1. FREON FAIL LIGHT IS "ON" (Lockout relay tripped)	
A. Loss of Freon.	Check Freon liquid level in condenser. If level indication is low, recharge Freon package, adding oil if necessary. If gage indicator is within DRAIN-RECHARGE area, replace Freon package. Reset lockout relay.
B. Compressor motor relay malfunction or loss of 115/200-volt ac.	Check for continuity from pins A to B of Freon compressor motor relay. Measure voltage from T_1, T_2, T_3, to ground for 115/200-volt ac. If not correct voltage, check current limiters on NO. 2 AC ESS BUS. Replace limiters as needed. With disconnect plug to Freon compressor motor relay removed, place a jumper from pin B of relay to ground, and apply 28-volts dc to pin A. Relay should close and Freon compressor motor should start. If not, check continuity of airplane wiring to compressor motor. Repair as necessary.
C. Lockout relay malfunctioning.	Reset lockout relay and attempt to start Freon compressor motor. If unit will not start check that lockout relay is in open position, thus removing ground from Freon compressor motor relay. If lockout relay will not "reset", remove larger plug from lockout relay. Check for continuity between pins: F to C, compressor discharge overpressure switch, G to T, compressor motor overheat switch, H to S, compressor discharge overtemp switch, compressor motor protector; if any of these are closed, remove and replace malfunctioning unit. If compressor will not start, check for an open Freon compressor start time delay (thermister). If no continuity through a resistance is found, repair wiring or replace time delay thermister.

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
1. FREON FAIL LIGHT IS "ON" (Lockout relay or compressor overspeed control has tripped) (CONT)	
D. Inadequate temperature drop across Freon expansion valve.	Check temperature of compressor motor sump and check to see if a temperature drop exists across expansion valve. If no appreciable temperature drop shut down compressor immediately, if compressor discharge overheat switch has not already done so. The malfunction is due to a failed "closed" expansion valve or a plugged drier or strainer. Replace Freon compressor package.
E. Inadequate cooling of condenser.	Freon compressor operates but package shuts down after a short time. Malfunction is due to improper condenser cooling. Check operation of condenser fan, condenser ground cooling valve, air shutoff valve, and condenser cooling air modulating valve. Replace malfunctioning unit after checking its operation with GS-2178.
F. Improper regulation of Freon back pressure valve.	Place an AC ammeter in one leg of 115/200-volt ac line to Freon compressor motor. Adjust sequencing device for full cooling; ammeter should not read more than 88-amps (measuring between terminals A and B of current transformer, and AC voltmeter should read 8.67-volts rms). NOTE: Be sure that the Freon compressor is working under maximum compression. If above this value, Freon back pressure control should be adjusted. If correct voltage cannot be attained, replace back pressure control.
G. Freon compressor motor overheats.	If Freon compressor operates but shuts down when operated in minimum cooling with surge bypass functioning, trouble is a failed "closed" motor cooling expansion valve. Replace Freon package.

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
2. FREON COMPRESSOR WILL NOT START (Lockout relay not tripped)	
A. Open limit switch circuit in Freon back pressure valve.	Remove power plug from back pressure regulator valve and check for continuity between terminals A and H of valve regulator. If open, use back pressure control test set GS-1279 and check for reference and control voltages. If no reference or control voltages, remove input plug to back pressure control, and check for 115-volt ac between pins C and D of removed plug. If 115-volt ac is present, remove and replace back pressure control.
B. Loss of 115-volt ac to control unit.	If no 115-volt ac present at input to back pressure control, remove outlet plug from lockout relay. Check between E to K of lockout relay receptacle. If voltage exists, trouble is between lockout relay and back pressure regulator; repair wiring as necessary. If no voltage, remove input plug to lockout relay and measure between pins R and M of removed plug. If correct voltage exists, trouble is in system control. (Refer to 21-0, Trouble Shooting.) If 115-volt ac is present, trouble is in lockout relay; remove and replace relay.
C. Loss of circuit control to back pressure regulator.	Remove input plug to back pressure control and check for continuity between terminals A and B of receptacle. If continuity is complete, trouble is in lockout relay or in wiring between units. Repair as necessary. If continuity is open, trouble is in control; remove and replace.
D. Back pressure regulating valve malfunction.	If reference and control voltage are correct, monitor position of valve with test set GS-1279. If valve closes, limit switch is defective. Remove and replace Freon package. If valve does not close, malfunction is within back pressure valve; remove and replace Freon package.

POSSIBLE CAUSE	ISOLATION PROCEDURE AND CORRECTION
2. FREON COMPRESSOR WILL NOT START (Lockout relay not tripped) (CONT)	
E. Malfunction in back pressure control.	Remove input plug to back pressure control (small plug) and check for 28-volt dc from pin E to ground. If voltage is present, remove and replace back pressure control. If voltage is not present, remove output plug from lockout relay and check for 28-volt dc from pin W to ground. If voltage is present, trouble exists in harness between lockout relay and back pressure control; repair as necessary. If correct voltage does not exist, remove plug to lockout relay and measure between pin H to ground of removed plug for 28-volt dc. If no voltage, malfunction is in system control. (Refer to 21-0, Trouble Shooting.) If 28-volt is present, malfunction is in lockout relay; remove and replace lockout relay.

FREON REFRIGERATION ASSEMBLY (FREON PACKAGE) - MAINTENANCE PRACTICES

1. Service Freon Package

CAUTION: THE FOLLOWING SERVICING PROCEDURE APPLIES ONLY WHEN ADDING FREON AND/OR OIL TO AN OPERATIONAL FREON PACKAGE. CHARGING A COMPLETELY VACATED PACKAGE OR A MALFUNCTIONING PACKAGE WHICH HAS BEEN REPAIRED MUST BE ACCOMPLISHED AT OVERHAUL.

A. Equipment Required.

(1) External source of 115/200-volt, 3 phase 400 cps ac electrical power.

(2) Freon 114 supply bottle containing not more than 10 parts of water per million parts of liquid Freon.

(3) Provisions for heating Freon supply bottle to a maximum of 130 degrees F (54 degrees C).

(4) Flexible hose charging line, containing a desiccant dryer, to connect supply bottle to Freon package. A Hansen quick-disconnect fitting (Type 1-K11) is required to connect charging line to Freon condenser.

(5) A scale to weigh Freon supply bottle. Freon bottle weighs approximately 50 pounds.

(6) Safety goggles.

WARNING: FREON, WHEN RELEASED TO ATMOSPHERE WILL VAPORIZE RAPIDLY AND IN DOING SO WILL ABSORB HEAT FROM ANY SURFACE IT CONTACTS. ADEQUATE SAFETY GOGGLES MUST BE WORN AT ALL TIMES WHEN SERVICING OR WORKING ON ANY FREON SYSTEM.

B. Check Freon Liquid Level.

NOTE: When operating Freon package to determine Freon quantity, evaporator and condenser inlet air temperatures must be as close to 100 degrees F (37.8 degrees C) as possible. If ambient outside air temperature is low, perform check with airplane in sheltered area.

(1) Connect and apply external electrical power to airplane (refer to Chapter 24, ELECTRICAL POWER).

(2) Start air-conditioning system and check Freon liquid level as follows:

(a) Place AUTO-OFF-MAN temperature control switch in MAN position. Toggle manual temperature control MAN HOT-MAN COLD switch to MAN HOT position, then toggle toward MAN COLD position until

Freon package starts operating. Hold manual temperature control switch in MAN COLD position for a minimum of 80 seconds after Freon package starts operating. (This will place the sequencing device in the full cold position.) When maximum cooling is obtained, hold manual temperature control switch in MAN HOT position for 30 seconds.

(b) After approximately 10 minutes of operation, and with Freon package still operating, observe liquid level indicator on Freon quantity gage. (Gage is visible through small round window in Freon package access door.)

NOTE: Freon quantity readings shall be taken only when Freon package is operating. Gage readings taken when Freon package is shut down are not accurate as liquid Freon may be trapped in various components of the package.

(3) Freon quantity gage indicator shall be within the green area (OPERATING RANGE) of dial.

(4) If gage indicator is within red (ADD CHARGE) area of dial, the package must be charged with Freon until gage indicator is within green (OPERATING RANGE) area.

CAUTION: IF GAGE INDICATOR IS WITHIN "DRAIN-RECHARGE" AREA, THERE IS A POSSIBILITY THAT TOO MUCH LUBRICATING OIL HAS BEEN LOST WITH THE FREON. THE PACKAGE SHALL BE REPLACED.

(5) When a Freon package charge is low, an evaluation of the rate of Freon loss must be made. If the loss occurred over an extended period (several months) the package can be restored to normal operating capacity by adding Freon. However, if the loss of Freon occurred over a relatively short period, excessive Freon leakage is indicated and the package shall be replaced.

(6) Shut down air conditioning system.

C. Charge Freon Package.

CAUTION: REPEATED ADDITION OF FREON TO A LEAKY PACKAGE MAY LEAD TO A DEFICIENCY OF LUBRICATING OIL AND SUBSEQUENT DAMAGE TO THE FREON COMPRESSOR BEARINGS. IF FREQUENT RECHARGING OF THE FREON PACKAGE IS NECESSARY, ADD ONE OUNCE OF TEXACO CAPELLA AA OIL, FEDERAL SPECIFICATION VV-L-820, WITH EACH FOUR POUNDS OF FREON ADDED TO PACKAGE.

(1) Remove cap and open Hansen fitting at top of Freon condenser and leave open approximately one minute to purge air from Freon package.

NOTE: Step (1) shall be omitted if ambient temperature is below 50 degrees F (10 degrees C).

CONVAIR MODEL 30

MAINTENANCE MANUAL

TEMPORARY REVISION NO. 21-27.

Insert facing 21-3-1, Page 202, dated Nov. 15/62 (or subsequent).

The information in this temporary revision is applicable to airplanes not modified per Hamilton Standard Service Bulletin 21-19. For airplanes modified per Hamilton Standard Service Bulletin 21-19, use the information on Page 202.

Retain this temporary revision in your manual until applicable airplanes have been modified per noted service bulletin.

Page 202, step (3) should read "Freon quantity gage indicator shall be between the red "low-charge" mark and "fill" mark."

Step (4) should read "If gage indicator is below red mark, the package must be charged with Freon until gage indicator is at black mark."

CAUTION: IF GAGE INDICATES "0" OR BELOW, THERE.....

CONVAIR MODEL 30

MAINTENANCE MANUAL

TEMPORARY REVISION NO. 21-28.

Insert facing 21-3-1, Page 203, dated Nov. 15/62 (or subsequent).

The information in this temporary revision is applicable to airplanes not modified per Hamilton Standard Service Bulletin 21-19. For airplanes modified per Hamilton Standard Service Bulletin 21-19, use the information on Page 203.

Retain this temporary revision in your manual until applicable airplanes have been modified per noted service bulletin.

Page 203, step (9) should read "Recheck Freon liquid level gage (refer to Check Freon Liquid Level); if gage indicator is not up to black "fill" mark, repeat Freon charging procedures per steps (1) through (8).

(2) Connect flexible charging line to Freon supply bottle and warm bottle to 130 degrees F (54 degrees C) maximum. Crack shutoff valve on supply bottle and depress valve in Hansen fitting to purge air from flexible line and drier. Close valve on supply bottle after purging line.

(3) Disconnect Freon charging line from supply bottle and immediately pour one ounce of Texaco Capella AA oil, Federal Specification VV-L-820, into Freon charging line upstream of desiccant dryer; reconnect line to bottle immediately after adding oil.

(4) Invert Freon supply bottle so that liquid Freon will be supplied to Freon package.

(5) Note weight of Freon supply bottle.

(6) Connect flexible charging line to quick-disconnect fitting on top of Freon condenser.

(7) Open shutoff valve on Freon supply bottle and observe weight scale. When scale indicates approximately four pounds of Freon have left supply bottle, close shutoff valve on supply bottle.

NOTE: The Freon flow from the supply bottle will force the oil in the charging line into the Freon package.

(8) Disconnect charging line from Freon condenser and install cap on condenser quick-disconnect fitting.

(9) Recheck Freon liquid level gage (refer to Check Freon Liquid Level); if gage indicator is not within the green (OPERATING RANGE) area, repeat Freon charging procedure per steps (1) through (8).

(10) Place AUTO-OFF-MAN temperature control switch in OFF position.

(11) Shut off and remove external electrical power.

(12) Record amount of Freon and oil added to Freon package.

2. Removal/Installation Freon Package

A. Equipment Required.

Lift-truck or table capable of being raised or lowered while supporting Freon package.

NOTE: Supporting surface must be large enough to reach the four support feet on the package, and small enough to allow access to the package for shifting slightly during the raising and lowering process. A Freon package weighs approximately 200 pounds.

B. Preparation.

(1) Remove electrical power from system.

CAUTION: WHEN REMOVING CABIN (RH SIDE) FREON PACKAGE, OPEN CABIN FREON SYSTEM CONTROL AND CABIN ELEC TEMP CONTROL CIRCUIT BREAKERS. REMOVE THREE FREON COMPR AIR COND FUSES FROM THE NO. 2 ESSENTIAL AC BUS.

WHEN REMOVING THE FLIGHT COMPARTMENT (LH SIDE) FREON PACKAGE, OPEN FLIGHT DECK FREON SYSTEM CONTROL AND FLIGHT DECK ELEC TEMP CONTROL CIRCUIT BREAKERS. REMOVE THREE FREON COMPR AIR COND HTR FUSES FROM THE NO. 4 NON ESSENTIAL AC BUS.

THE CIRCUIT BREAKERS ARE LOCATED ON THE MAIN CIRCUIT BREAKER PANEL. THE FUSES ARE LOCATED ON THE AC POWER DISTRIBUTION PANEL BELOW THE FLIGHT ENGINEER'S CONTROL PANEL. DO NOT OPEN THE AC POWER DISTRIBUTION PANEL WHEN THE BATTERY IS ON, THE ENGINES ARE RUNNING, OR WHEN EXTERNAL POWER IS CONNECTED.

(2) Open Freon package access door (cabin or flight compartment as required).

C. Remove Freon Package (see Figure 201).

(1) Release three hose clamps (two on forward end and one on aft end) that secure Freon package ducts to airplane ducts.

(2) Remove two hose clamps aft of branched condenser cooling duct and remove branched duct.

(3) Disconnect package control power receptacle at forward end of lockout relay. (Tag for installation.)

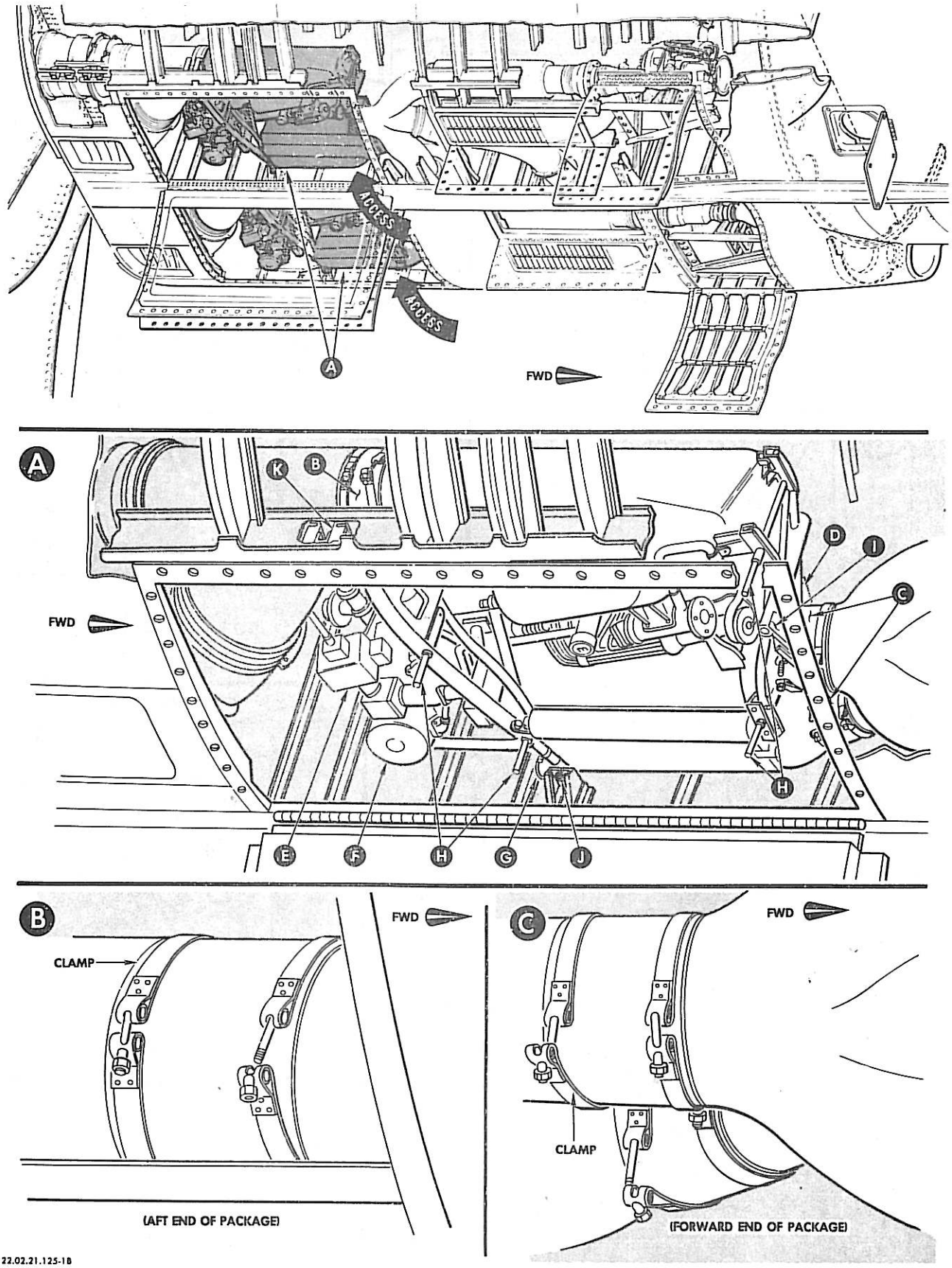
(4) Disconnect electrical connector from sequencing device.

NOTE: The flight compartment sequencing device harness has three clamps which secure the harness to the package. Remove clamps from package and leave them attached to harness. A replacement package will not have clamps.

(5) Disconnect power leads from Freon compressor motor. To remove leads, turn terminal caps counterclockwise and slide back to expose terminal connection. (Tag leads for installation.)

(6) Disconnect mounting frame ground strap.

(7) Remove locking pins and extend four support feet below the package.



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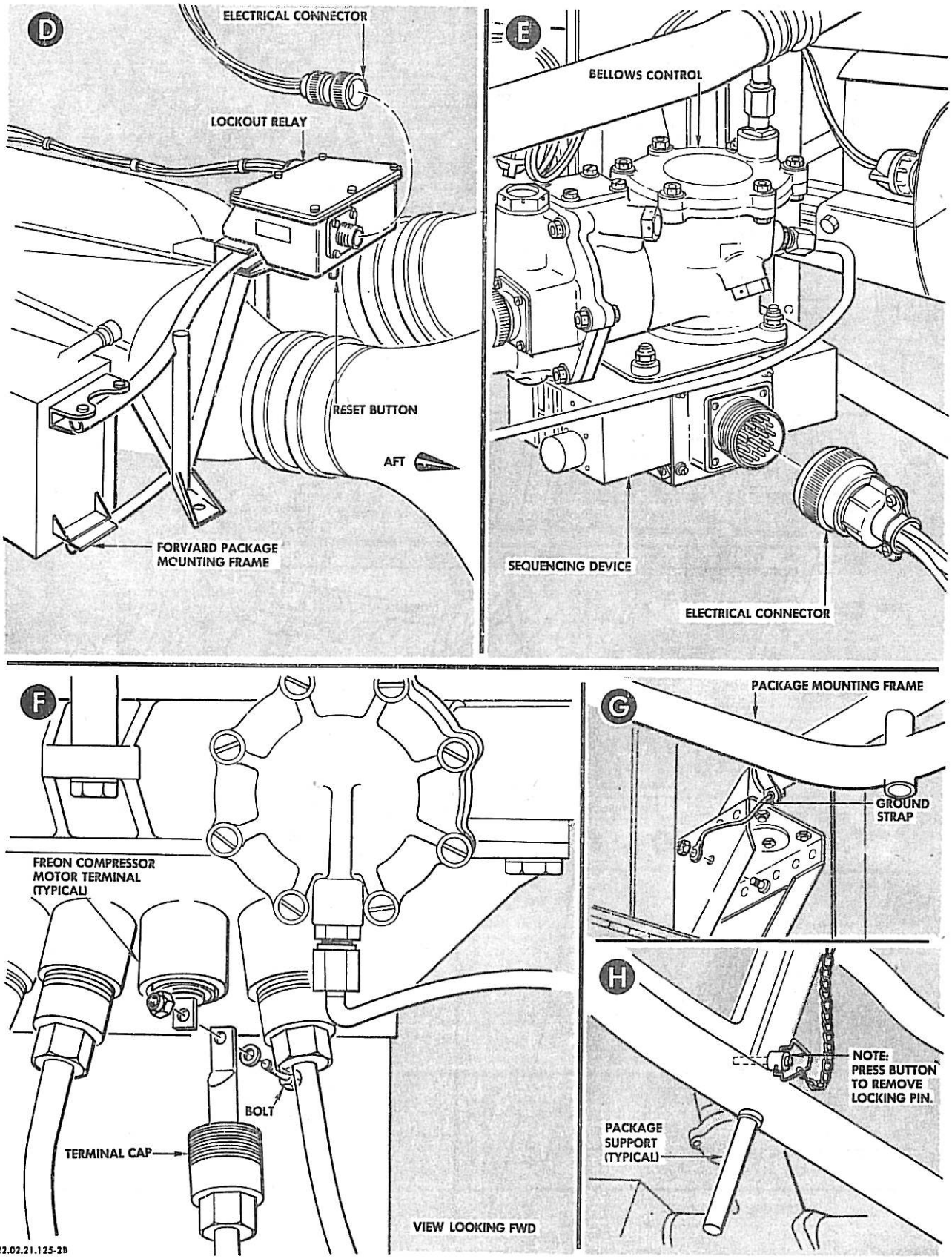
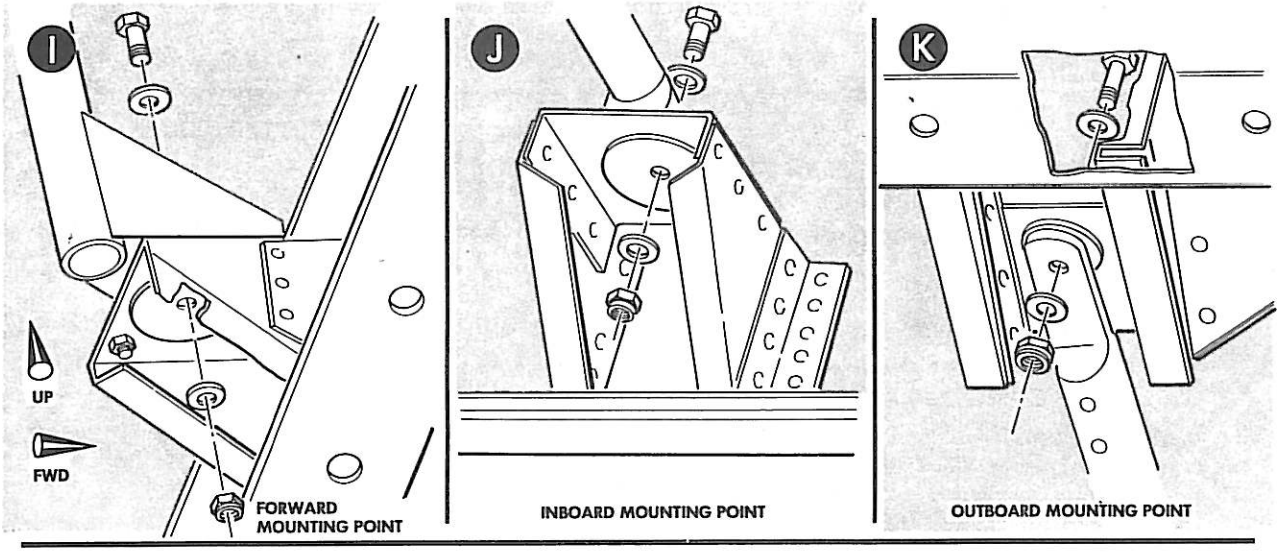
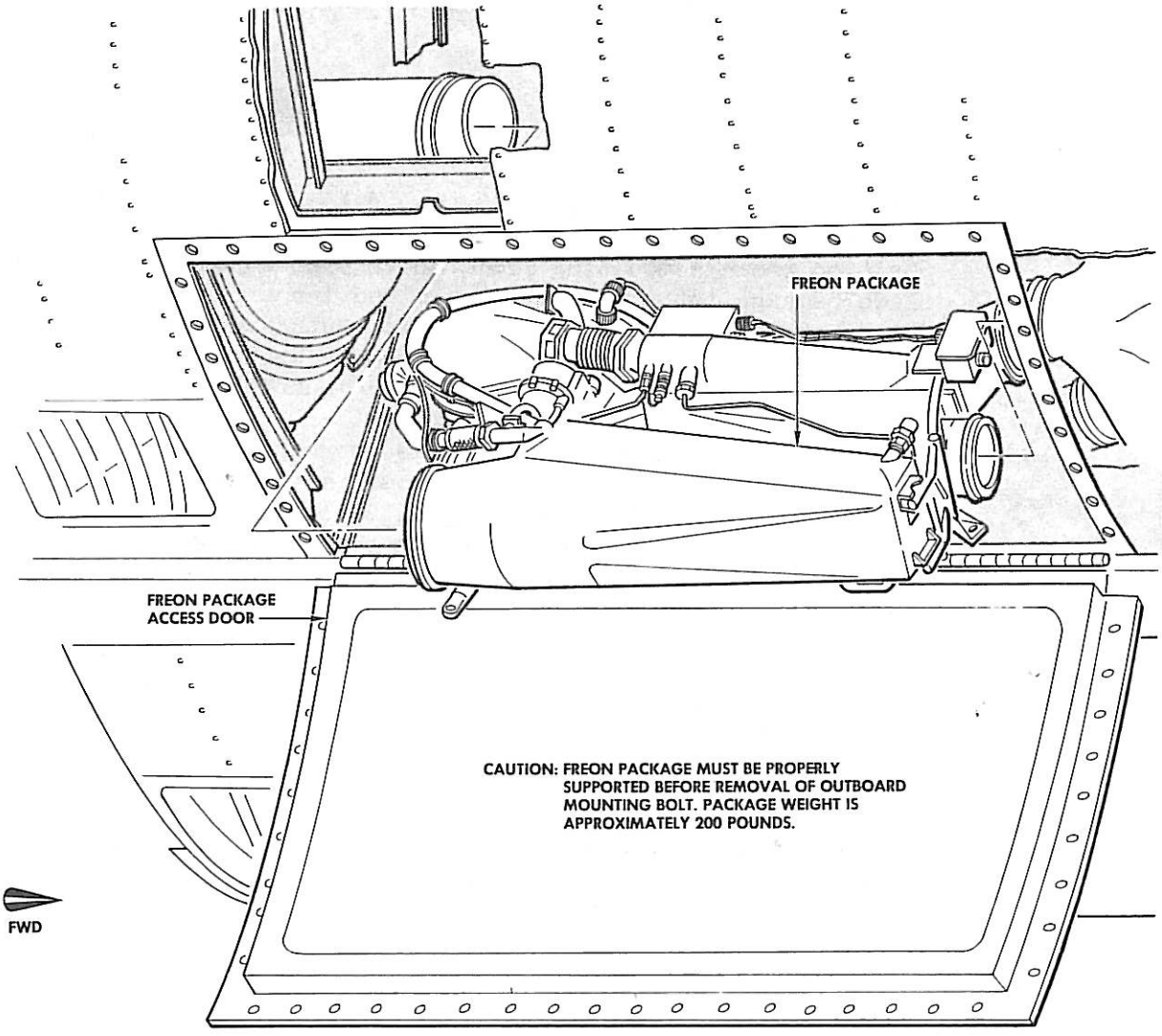

D
ELECTRICAL CONNECTOR
LOCKOUT RELAY
RESET BUTTON
AFT
FORWARD PACKAGE MOUNTING FRAME
E
BELLOWS CONTROL
SEQUENCING DEVICE
ELECTRICAL CONNECTOR
F
FREON COMPRESSOR MOTOR TERMINAL (TYPICAL)
BOLT
TERMINAL CAP
VIEW LOOKING FWD
22.02.21.125-28
G
PACKAGE MOUNTING FRAME
GROUND STRAP
H
NOTE: PRESS BUTTON TO REMOVE LOCKING PIN.
PACKAGE SUPPORT (TYPICAL)





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(8) Remove package mounting bolts from forward and inboard mounting points.

CAUTION: USE A LIFT TRUCK OR SIMILAR DEVICE TO SUPPORT FREON PACKAGE BEFORE REMOVING OUTBOARD MOUNTING BOLT. PACKAGE WEIGHS APPROXIMATELY 200 POUNDS.

(9) With Freon package properly supported, remove outboard mounting bolt.

(10) Remove Freon package by lowering outboard edge and then sliding package outboard to clear forward and inboard mounting points. Lower package clear of airplane.

(11) Remove sequencing device and hold for installation on replacement package (refer to 21-4-4, Maintenance Practices).

D. Install Freon Package (see Figure 201).

(1) Refer to Paragraphs A and B.

(2) Tie power leads and electrical connectors clear of area occupied by the Freon package.

(3) Using lift truck or similar device, raise package to within a few inches of its mounted position. Then raise inboard edge to position package mounting frame above support bracket in airplane. Slide package inboard with forward and inboard package mounting points above support brackets. Raise outboard mounting point into position below airplane support bracket. Slight shifting may be necessary to install the three mounting bolts.

NOTE: Freon package mounting frame goes above airplane support brackets at forward and inboard mounting points. Freon package mounting frames goes below airplane support bracket at outboard mounting point.

(4) Install three mounting bolts, washers and nuts to secure package in airplane.

(5) Remove lift truck or supporting device, raise the four package support feet, and secure feet with locking pins.

(6) Install branched condenser cooling duct at aft end of package.

(7) Position hoses and install three duct connecting clamps. (Two on forward end and one on aft end of package.)

(8) Connect power leads to Freon compressor motor. Slide terminal caps on power leads and connect lugs to motor terminals with bolts and nuts. Then slide terminal caps up to motor and screw into place. Tighten terminal caps to 100 to 150 inch-pounds and install safety wire.

CAUTION: RECHECK LEADS TO INSURE CONNECTION TO PROPER TERMINAL.

(9) Install sequencing device (refer to 21-4-4, Maintenance Practices).

(10) Connect and safety wire package control harness to forward end of lockout relay.

NOTE: Secure control harness to flight compartment (LH side) Freon package with three clamps.

(11) Attach ground strap from airplane to package mounting frame.

(12) Install three FREON COMP AIR COND fuses (No. 2 ESS AC BUS) and three FREON COMPR AIR COND HTR fuses (No. 4 NONESSENTIAL AC BUS) in ac power distribution panel (below flight engineer's control panel).

(13) Close FREON SYSTEM CONTROL and ELEC TEMP CONTROL circuit breakers.

(14) Check operation of air conditioning system (refer to 21-0 Maintenance Practices).

(15) Recheck security of duct clamps and electrical connectors on Freon package.

(16) Close Freon package access door.

3. Inspection/Check

A. Maintenance Check.

(1) Examine Freon package frame support tubing and welds.

(a) Frames shall be free from visible cracks.

(b) Mounting point locknuts shall be tight.

(c) Nuts and bolts that connect components of Freon package shall be secure.

(2) Examine mounting brackets on Freon package that connect to the airplane. Each mounting bracket shall be securely attached to its respective member and it shall be free from cracks.

(3) Examine all Janitrol and Marman clamps. They shall be tight and free of visible cracks.

(4) Examine all electrical connectors. They shall be secured to their respective socket, and wiring shall be free of fraying, excessive vibration or wear.

(5) If Freon package is removed from airplane, examine all cabin air and ram air passages of vapor cycle system for cracks, leaks or for foreign material which tends to restrict air flow.

(6) Examine rubber blowout plug on condenser relief valve; plug shall be in place.

4. Cleaning/Painting

A. Clean Freon Package - Clean exterior surfaces with solvent, Specification AMS 3160A to remove any dirt, grease or oil deposits (as required).

WARNING: EXERCISE CARE TO INSURE THAT SOLVENT DOES NOT ENTER CABIN AIR PORTS OF PACKAGE. APPLY SOLVENT WITH SOFT CLOTH MOISTENED (NOT SATURATED) WITH SOLVENT.

B. Paint Freon Package.

(1) Touch up worn or damaged painted surfaces as follows:

(a) Remove all corrosion with steel wool or crocus cloth prior to application of primer coat.

(b) Apply primer coat of zinc chromate ASM 3110C to obtain semi-transparent greenish-yellow surface.

(c) Allow primer to air-dry 30 minutes at room temperature.

(d) Apply two topcoats of glyceryl phthalate black enamel, AMS 3120B.

(e) Allow each coat of enamel to air-dry 4 hours at room temperature before applying second coat or before handling.

5. Approved Repairs

A. Remove all dents or scratches from Freon package air passages.

(1) Remove dents, accessible from the inside of the ducts, with a rawhide hammer.

(2) Polish out scratches with crocus cloth.

(3) Remove burrs from clamp flanges with fine crocus cloth.

B. During line maintenance, the following components may be replaced in the Freon package without disturbing the Freon loop. The removal and installation procedures are included in the maintenance practices of the individual component.

(1) Sequencing Device.

(2) Thermal Resistor and Connector.

(3) Condenser Temperature Control.

(4) Back Pressure Control.

(5) Freon Lockout Relay.

(6) Compressor Motor Protector.

C. When repairs require that Freon loop be opened, Freon package should be replaced due to time required for draining, purging and recharging Freon system.

AIR-TO-AIR HEAT EXCHANGER - MAINTENANCE PRACTICES

1. Removal/Installation - Air-to-Air Heat Exchanger (see Figure 201)

   A. Equipment Required - None.

   B. Preparation.

      (1) Open FREON SYS CONT and ELEC TEMP CONTROL circuit breakers (cabin or flight compartment).

      (2) Open heat exchanger access doors (cabin and flight compartment).

   C. Remove Cabin Air-to-Air Heat Exchanger.

      (1) Remove nuts, bolts, and washers from connecting flanges on both ends of 45 degree duct section.

      (2) Disconnect clamps and remove long, straight section of duct which is installed above 45 degree duct.

      (3) Remove locking pins and release clamp securing emergency pressurization duct (small duct perpendicular to exchanger inlet duct) to forward end of heat exchanger.

      (4) Remove hose clamps from connecting ducts on forward and aft ends of heat exchanger.

      (5) Disconnect electrical connector from heat exchanger cooling air modulating valve actuator. (Tag for installation.)

      (6) Remove louver from under heat exchanger by removing screws from airplane exterior.

      (7) Remove mounting bolts from bottom of heat exchanger.

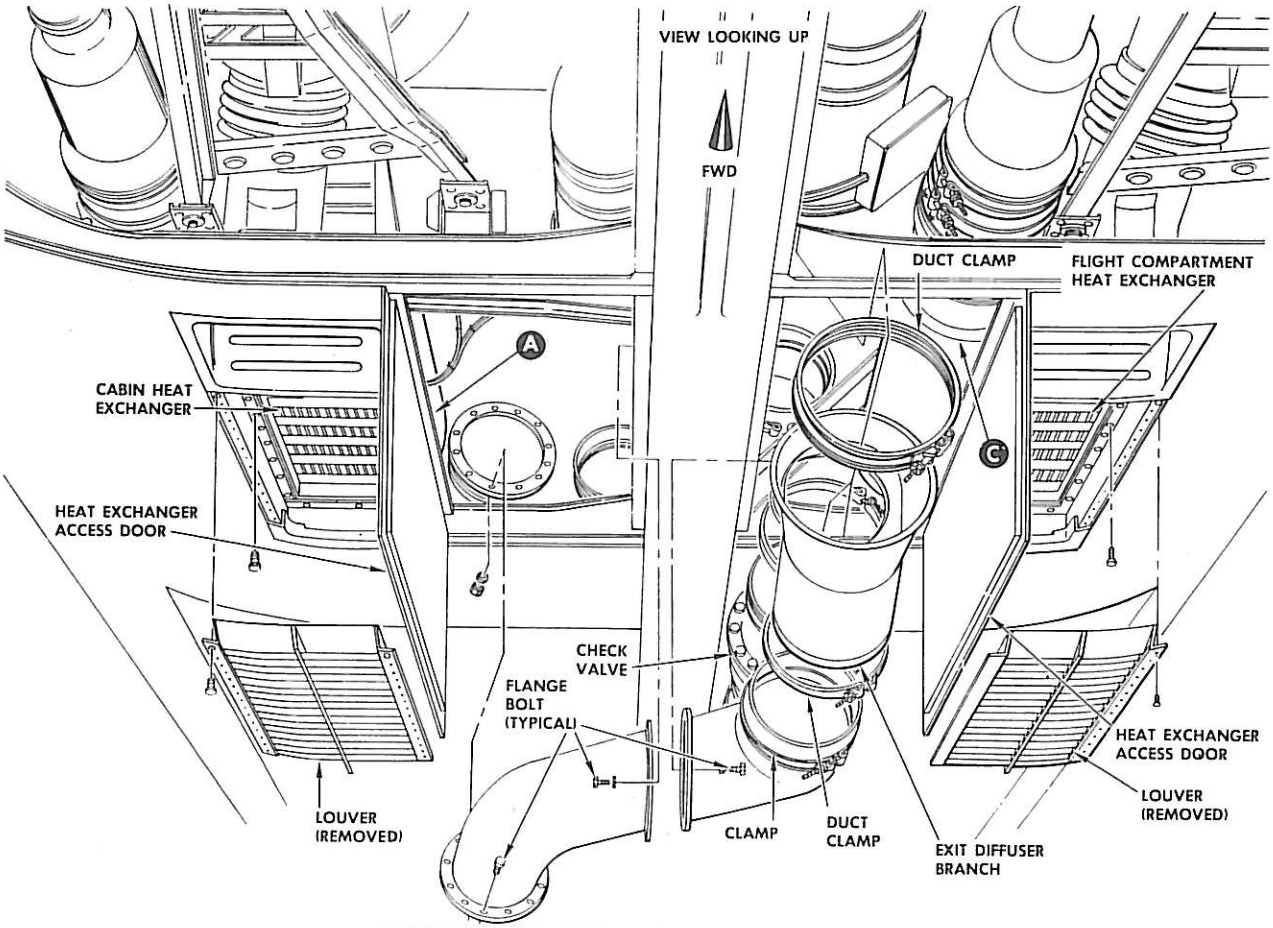
      (8) Remove heat exchanger with modulating valve through heat exchanger access door.

      (9) Separate modulating valve from heat exchanger by removing retaining bolts and washers on top of heat exchanger.

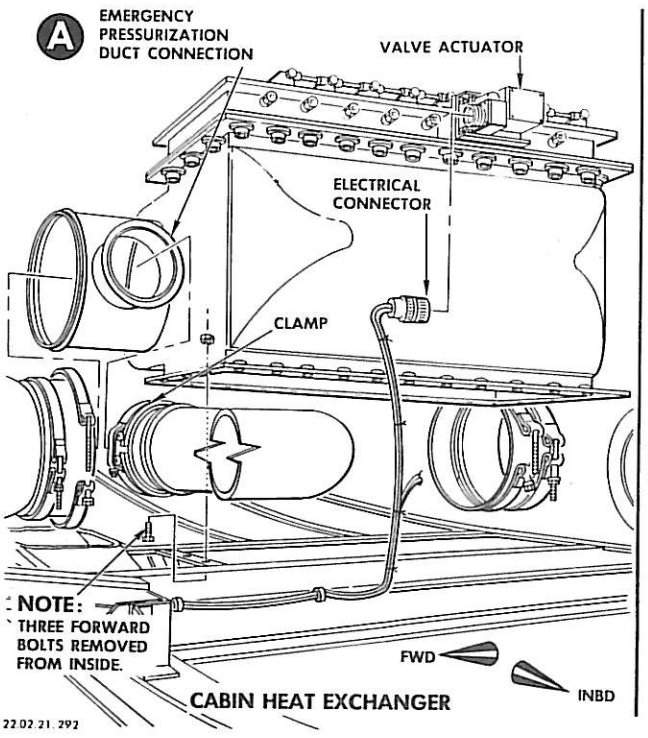
   D. Install Cabin Air-to-Air Heat Exchanger.

      (1) Position heat exchanger cooling air modulating valve and gasket on top of heat exchanger; install valve with valve actuator on inboard side.

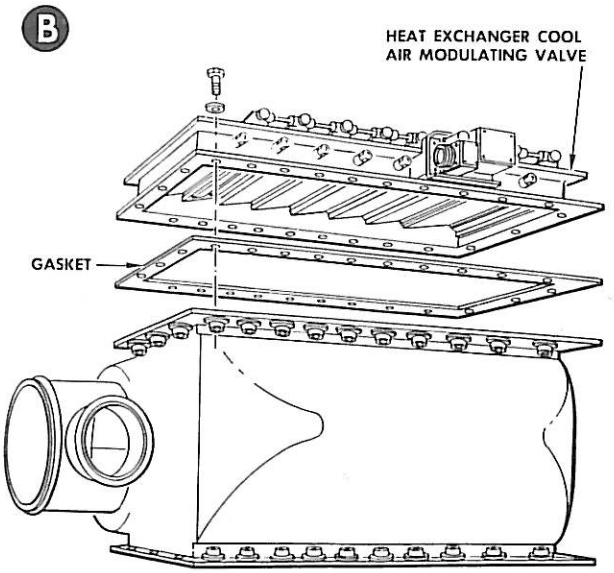
      (2) Install retaining bolts and washers to secure modulating valve to heat exchanger.



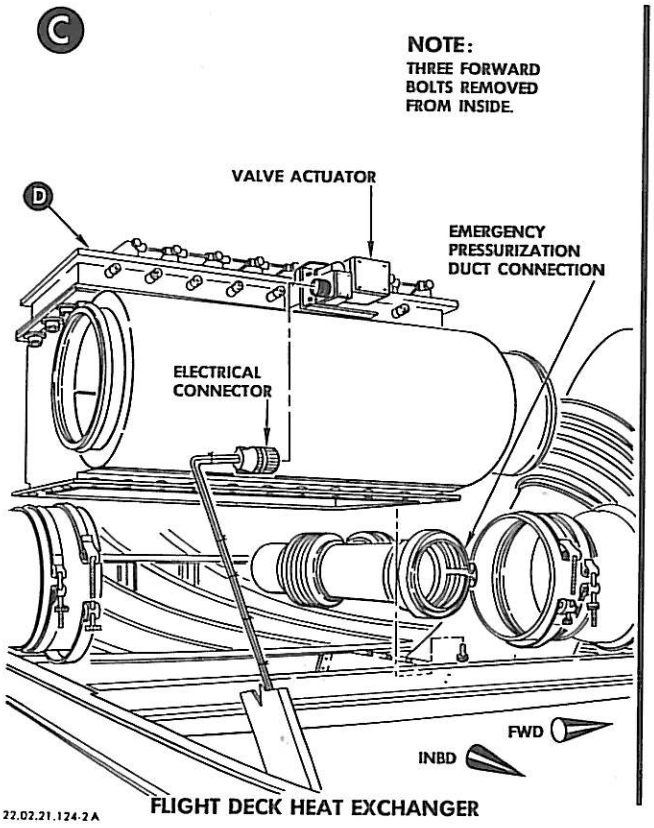
AFT END OF AIR CONDITIONING COMPARTMENT



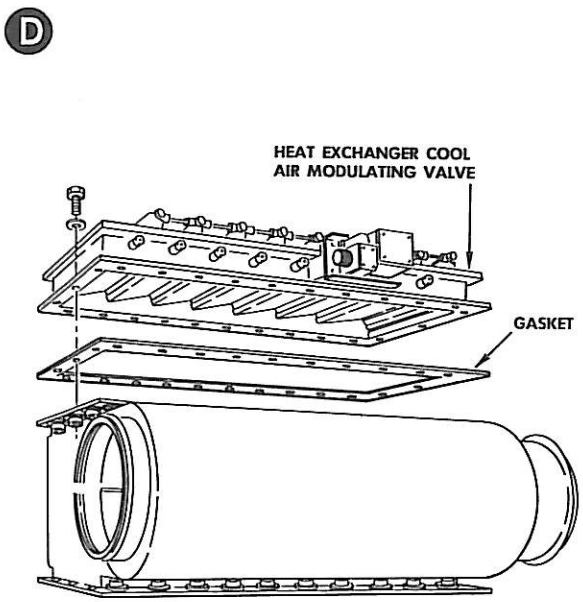
CABIN HEAT EXCHANGER



CABIN HEAT EXCHANGER REMOVED



FLIGHT DECK HEAT EXCHANGER



FLIGHT DECK HEAT EXCHANGER REMOVED

(3) Insert assembled heat exchanger and modulating valve through right-hand heat exchanger access door. Position heat exchanger on mounting base with emergency pressurization duct connection forward and valve actuator inboard; install heat exchanger retaining bolts from the bottom and secure.

(4) Position louver under heat exchanger with vanes pointing down and aft; install and secure retaining screws.

(5) Connect electrical connector to modulating valve actuator; secure connector with safety wire.

(6) Install connecting hose and clamps on forward and aft end of heat exchanger.

(7) Install connecting hose and clamp on emergency pressurization duct connection. Torque clamp nut to 100-120 inch pounds and install locking pin.

(8) Install long, straight section of duct.

(9) With new gasket in place, position 45 degree duct section and install and secure bolts, washers, and nuts in connecting flanges on both ends.

(10) Close heat exchanger access door.

(11) Close cabin FREON SYS CONT and cabin ELEC TEMP CONTROL circuit breakers.

(12) Perform operational check of system (refer to 21-0, Maintenance Practices).

E. Remove Flight Compartment Air-to-Air Heat Exchanger.

(1) Reaching through right heat exchanger access door, remove nuts, bolts, and washers from connecting flanges on forward end of 45 degree duct section.

(2) Reaching through left heat exchanger access door, remove branched duct section by releasing one clamp from forward end and two clamps from each of two aft ends.

(3) Remove duct section which passes through centerline bulkhead by removing bolts from mounting plate on left side of bulkhead.

(4) Remove short straight duct section which runs aft from top of branched duct by releasing hose clamps forward and aft of check valve. (Remove duct with check valve to eliminate having to remove flange bolts which connect duct to check valve.)

(5) Disconnect emergency pressurization duct (small duct perpendicular to exchanger inlet duct) at forward end of heat exchanger by removing locking pin and releasing hose clamp.

(6) Remove hose clamps from connecting ducts on forward and aft ends of heat exchanger.

(7) Disconnect electrical connector from heat exchanger cooling air modulating valve actuator. (Cap connector and tag for installation.)

(8) Remove louver from under heat exchanger by removing screws from airplane exterior.

(9) Remove mounting bolts from bottom of heat exchanger.

(10) Remove heat exchanger with modulating valve through heat exchanger access door.

(11) Separate modulating valve from heat exchanger by removing retaining bolts and washers from top of exchanger.

F. Install Flight Deck Air-to-Air Heat Exchanger.

(1) Position heat exchanger cooling air modulating valve and gasket on top of heat exchanger.

NOTE: The small emergency pressurization duct connection is on the forward end of the heat exchanger. The modulating valve actuator always faces inboard when the modulating valve is installed on the heat exchanger. The cabin and flight deck heat exchangers can be interchanged if the cooling air modulating valves are turned around.

(2) Install retaining bolts and washers to secure modulating valve to heat exchanger.

(3) Insert assembled heat exchanger and modulating valve through left-hand heat exchanger access door. Position on mounting base with emergency pressurization duct connection forward and valve actuator inboard; install heat exchanger retaining bolts from the bottom, and secure.

(4) Position louver under heat exchanger with vanes pointing down and aft; install and secure retaining screws.

(5) Connect electrical connector to modulating valve actuator; secure connector with safety wire.

(6) Install connecting hose and clamps on forward and aft ends of heat exchanger.

(7) Install connecting hose and clamp on emergency pressurization duct connection. Torque clamp nut to 100-120 inch-pounds and install locking pin.

(8) Position short straight duct section (with check valve aft) and secure to mounting bracket with clamp just ahead of check valve. Install hose and clamp aft of check valve.

(9) Position short duct section (with mounting plate) that passes through centerline bulkhead. Install mounting plate retaining bolts.

(10) Position branched duct section to connect recirculation fan outlet duct to straight duct section running aft, and to the 45 degree duct section which passes through centerline bulkhead. Install hose and clamps for the three connections.

(11) Reaching through right-hand heat exchanger access door, install gasket, and secure duct sections at flanged ends with bolts, washers, and nuts.

(12) Close heat exchanger access doors.

(13) Close flight deck FREON SYS CONT and flight deck ELEC TEMP CONTROL circuit breakers.

(14) Perform operational check of system (refer to 21-0, Maintenance Practices).

2. Inspection/Check

A. Examine exterior surfaces of heat exchanger as follows:

(1) Examine all flanges for cracks, scratches, or dents that might cause leakage at duct connections.

(2) Check elastic stop nuts on ram air flanges for damaged or deteriorated nylon inserts.

(3) Examine all mounting brackets for damage that may effect mounting angle.

(4) Examine painted surfaces for damage that exposes metal and check these areas for corrosion.

(5) Check all areas, especially seams, for cracks, dents, or cuts.

3. Cleaning/Painting

A. Clean Heat Exchanger.

(1) Clean exterior (painted) surfaces with solvent, Specification AMS 3160A to remove dirt, grease or oil deposits.

WARNING: DO NOT ALLOW SOLVENT TO ENTER HEAT EXCHANGER CORE. APPLY SOLVENT WITH SOFT LINTLESS CLOTH OR SOFT BRUSH.

(2) Clean ram air side of heat exchanger core with low pressure steam (approximately 25 psi). Do not attempt to clean cabin air side. Direct steam pressure from a nozzle against the cleanest side of ram air core. Flush steam blasted surfaces with cold water until evidence of dirt disappears from water. Immediately dry heat exchanger in oven at 230 to 240 degrees F (110 to 115.6 degrees C) for two hours or more, until all evidence of vapor disappears.

B. Paint Heat Exchanger.

(1) Touch up paint damage when extent of damage does not exceed five percent of total painted surface.

(a) Apply one coat of zinc chromate primer, Specification AMS 3110C, and allow to dry thoroughly (30 minutes minimum).

(b) Apply two coats of glyceryl phthalate black enamel, Specification AMS 3120B and allow each coat to dry for four hours.

HEAT EXCHANGER COOLING AIR MODULATING VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Heat Exchanger Cooling Air Modulating Valve

NOTE: The heat exchanger cooling air modulating valve and heat exchanger must be removed from the airplane as an assembled unit. After removal from the airplane, the two components are separated (refer to 21-3-2, Maintenance Practices).

RECIRCULATION FAN - MAINTENANCE PRACTICES

1. Removal/Installation Recirculation Fan (see Figure 201)

   A. Equipment Required - None.

   B. Preparation.

      (1) Open RECIRC FAN CONT circuit breaker.

      (2) Remove three RECIRC FAN MOTOR limiters from No. 3 ac ESS BUS power distribution panel located below flight engineer's control panel.

      WARNING: DO NOT OPEN AC POWER DISTRIBUTION PANEL WHEN BATTERY IS ON, ENGINES ARE RUNNING, OR WHEN EXTERNAL POWER IS CONNECTED TO AIRPLANE.

      (3) Open flight compartment (LH side) turbocompressor access door.

   C. Remove Recirculation Fan.

      (1) Remove cover from fan relay box. (Relay box is attached to fan which is mounted in duct running next to centerline bulkhead.)

      (2) Disconnect motor power leads from power terminal. (Power leads are the large wires.)

      NOTE: Power leads are tagged "T1", "T2" and "T3" to insure proper connection to their respective terminals.

      (3) Disconnect three leads from relay terminals A, B, and C. (Tag leads to insure proper connection upon installation.)

      (4) Slide disconnected leads through grommets in relay box.

      (5) Replace cover on relay box.

      (6) Release duct clamps on each end of recirculation fan.

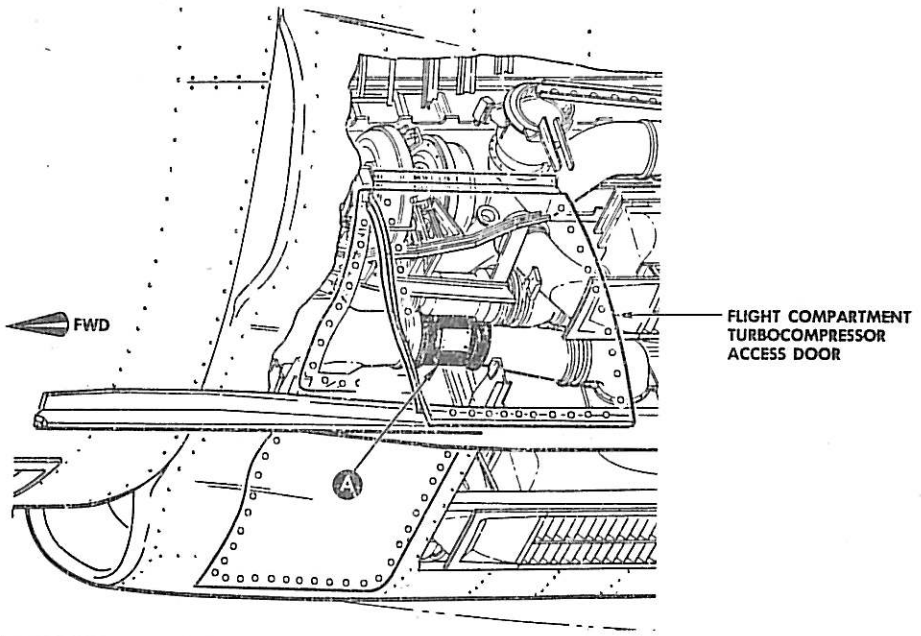
      (7) Remove nuts from three mounting bracket attach bolts securing fan to centerline bulkhead. (Leave bolts in place.)

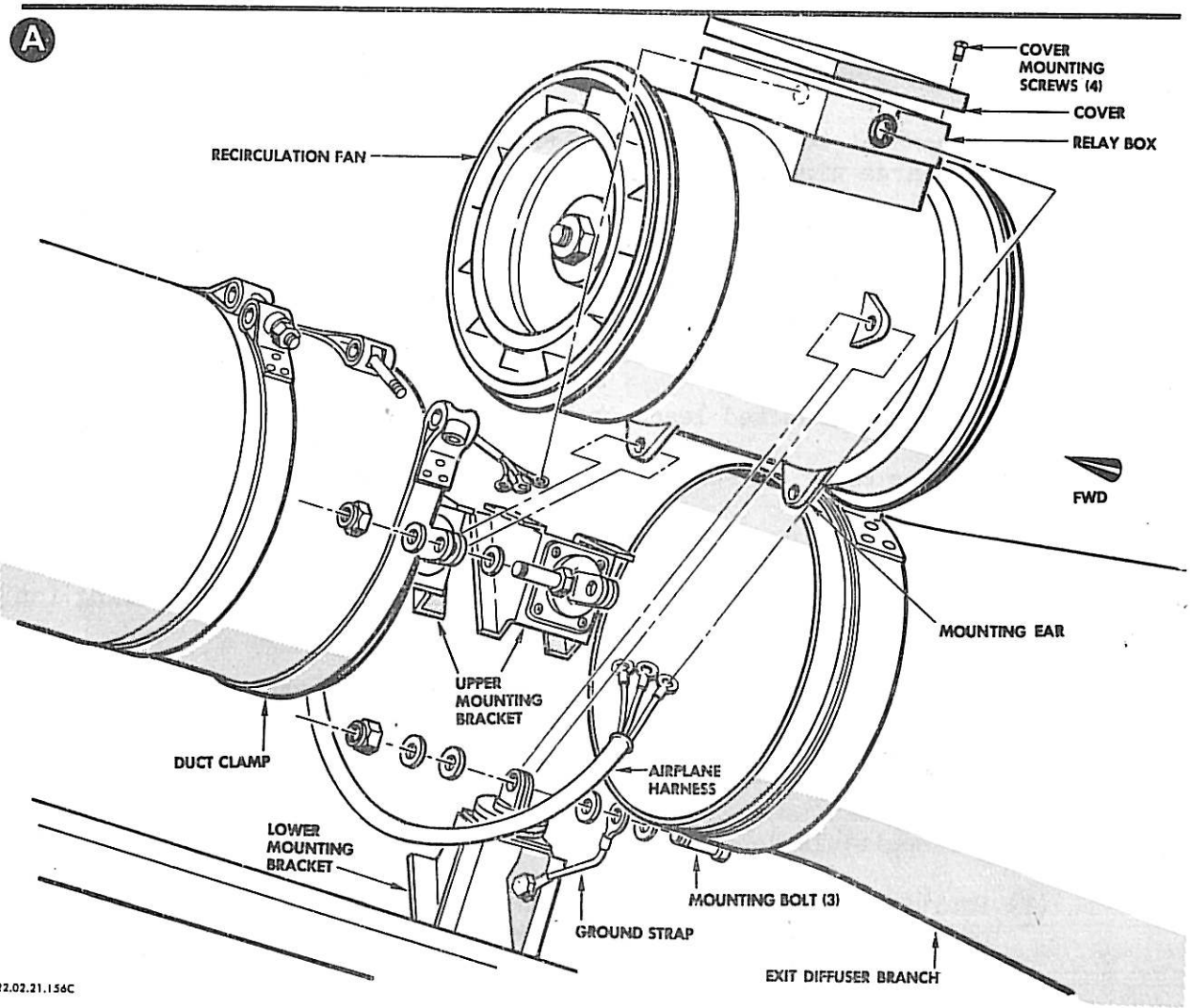
      (8) Remove lower mounting bolt and disconnect ground strap.

      (9) While supporting fan, remove remaining two mounting bolts and remove fan.

   D. Install Recirculation Fan.

      (1) Position fan against centerline bulkhead with three mounting ears on fan in line with mounting brackets on bulkhead; install bolts loosely in two upper brackets but do not secure at this time.





Recirculation Fan Installation
Figure 201

(2) Place third mounting bolt through ground strap and fan lower mounting ear; install bolt in fan lower mounting bracket.

(3) Install and tighten nuts on three mounting bolts.

(4) Position duct hose and install duct clamps on each end of fan.

(5) Remove cover from relay box.

(6) Slide power leads (large wires) and relay control leads through grommets in side of relay box.

(7) Connect power leads to proper terminals. (Carefully check identification tags on power leads.)

(8) Connect control leads to relay terminals A, B, and C. (Carefully check identification tags on leads.)

(9) Install cover on relay box; secure mounting screws with safety wire.

(10) Install three RECIRC FAN MOTOR limiter in No. 3 ac ESS BUS power distribution panel.

CAUTION: DO NOT OPEN AC POWER DISTRIBUTION PANEL WITH BATTERY ON, ENGINES RUNNING, OR WITH EXTERNAL POWER CONNECTED TO AIRPLANE.

(11) Close RECIRC FAN CONT circuit breaker.

(12) Operate recirculation fan for at least 15 minutes. There shall be no indication of malfunction and no sign of overheating.

NOTE: If direction of rotation is wrong, recheck power leads for proper connection.

(13) Close flight compartment turbocompressor access door.

2. Inspection/Check

A. Examine Fan Exterior.

(1) Check mounting beads; they shall be without cracks, scratches or other damage that might impair effective sealing.

(2) Examine mounting ears; they shall be free from damage or wear.

(3) Fan duct housing shall be smooth and free from dents or damage.

(4) Any exposed metal shall be free from corrosion.

(5) Examine relay box for secure attachment to fan housing.

(6) Check relay box exterior; walls shall be smooth and free from dents, nicks or other damage.

3. Cleaning/Painting

A. Clean Fan Exterior.

(1) Remove grease and oil deposits using a soft lintless cloth moistened with solvent, Specification AMS 3160A.

WARNING: DO NOT IMMERSE UNIT IN SOLVENT.

(2) Allow cleaned surface to dry thoroughly. Use filtered compressed air, as required, for drying.

(3) Remove corrosion with fine crocus cloth.

B. Touch-up paint damage when extent of damage does not exceed 5 percent of total painted surface.

(1) Apply one coat of zinc chromate primer, Specification AMS 3110C and allow to dry thoroughly (30 minutes min.).

(2) Apply two coats of glyceryl phthalate black enamel, Specification AMS 3120B and allow each coat to dry 4 hours.

RECIRCULATION CONTROL VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Recirculation Control Valve

   A. Equipment Required - None.

   B. Preparation.

      (1) Remove flight compartment (left side) turbocompressor package (refer to 21-1-1, Maintenance Practices).

      (2) Open RECIRC FAN CONT and cabin ELEC TEMP CONTROL circuit breakers.

   C. Remove Recirculation Control Valve.

      (1) Disconnect electrical connector from receptacle on valve actuator housing. Valve is located on duct near the centerline bulkhead, and about three inches from forward bulkhead of plenum chamber. (Cap connector and receptacle. Tag harness for installation.)

      (2) Remove nut, bolt, and clamp and disconnect bonding jumper from valve actuator shaft housing on left outboard side of valve.

      (3) Disconnect aft end of valve by releasing hose clamp.

      (4) Disconnect forward end of valve by removing nuts, washers, and bolts from connecting flange.

      (5) Remove valve and gasket.

   D. Install Recirculation Control Valve.

      NOTE: Flight compartment turbocompressor package must be removed for access to recirculation control valve.

      (1) Position valve between opening in air duct. The connecting flange and gakset shall be forward. Valve actuator shall be at 7 o'clock position when viewed from aft end.

      (2) Install bolts, washers, and nuts in connecting flanges to secure forward end of valve to recirculation duct.

      (3) Position hose and install clamp to secure aft end of valve.

      (4) Connect electrical connector to receptacle on valve actuator housing.

      (5) Connect bonding jumper to valve actuator shaft housing and secure with clamp, bolt and nut.

      (6) Close RECIRC FAN CONT and ELEC TEMP CONTROL circuit breakers.

NOTE: Operational check may be performed prior to installation of turbocompressor package (refer to 21-0, Maintenance Practices).

(7) Install turbocompressor package (refer to 21-1-1, Maintenance Practices).

(8) Perform operational check if it was not done prior to installation of turbocompressor package.

2. Inspection/Check

A. Examine valve exterior as follows:

(1) Check valve actuator electrical receptacle for damaged or worn threads; check pins for looseness or bending.

(2) Examine inlet and outlet connecting beads for cracks, scratches, grooves or other damage that might cause leakage.

(3) Check actuator mounting bolts and shaft end plug for tightness.

(4) Examine all surfaces for damage or wear.

(a) Check painted areas for damaged or worn surface treatment.

(b) Check any exposed metal for corrosion.

(c) Check actuator cover for dents that might affect operation.

3. Cleaning/Painting

A. Clean valve bore and exterior surface with solvent, Specification AMS 3160A to wipe off dirt and grease deposits.

CAUTION: DO NOT IMMERSE VALVE IN CLEANER.

(1) Remove corrosion using a fine crocus cloth.

B. Touch up paint damage when total damage does not exceed 5 percent of the total painted area. Use black enamel Specification AMS 3120B and allow paint to dry at least 4 hours at room temperature.

4. Approved Repair

A. Repair valve by replacing actuator when required (see Figure 201).

(1) Remove actuator by removing nuts and washers.

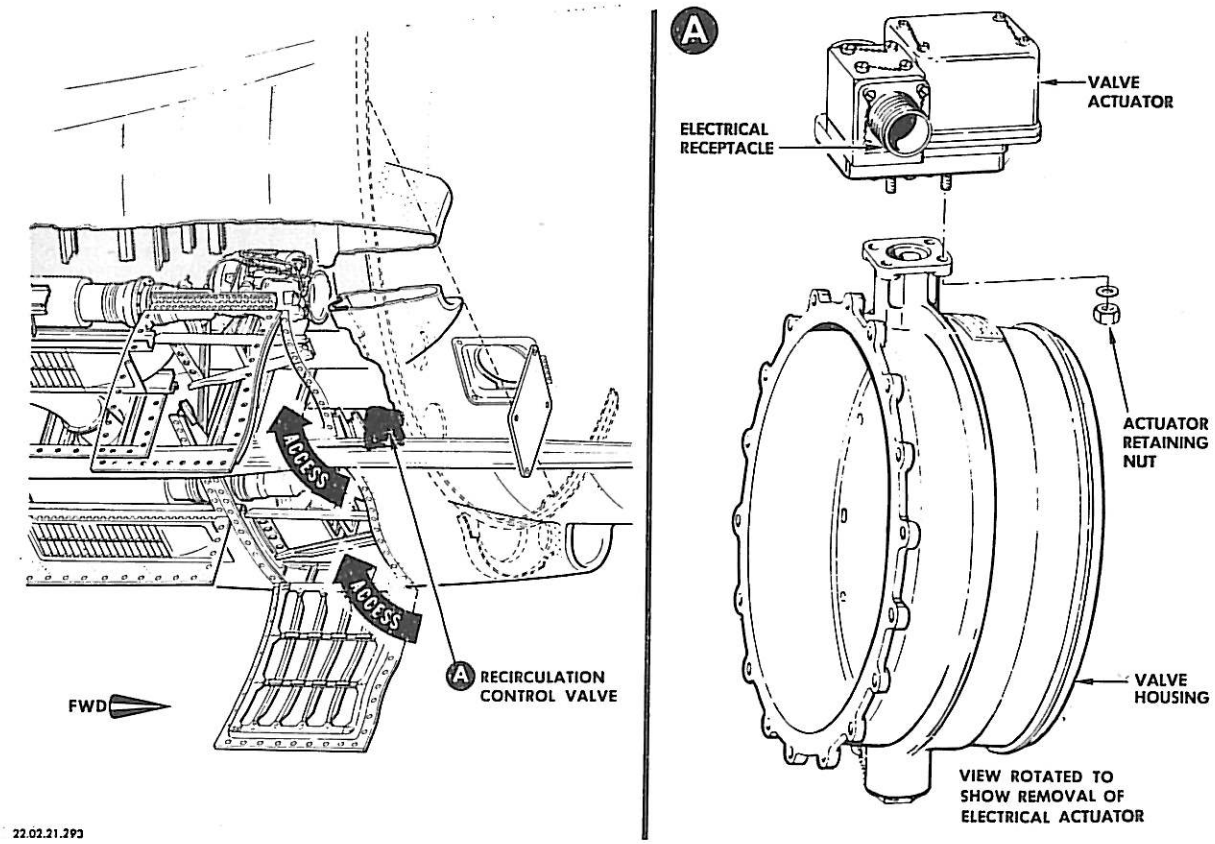
(2) Hold new actuator in position over shaft and rotate valve disc until shaft splines line up with actuator splines.

(3) Assemble actuator to valve and secure with retaining washers and nuts.

CAUTION: DO NOT ROTATE VALVE DISC WHEN ACTUATOR IS INSTALLED ON VALVE.

(4) Check valve performance.

B. Additional valve repair is limited to corrosion removal and paint retouching.



RECIRCULATION AIR CHECK VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Recirculation Air Check Valve

A. Equipment Required - None.

B. Preparation.

(1) Open heat exchanger access door (cabin or flight compartment as required).

C. Remove Cabin Recirculation Air Check Valve.

(1) Release hose clamp aft of recirculation air check valve.

NOTE: If the Freon package is not installed, the nose clamp is easier to reach from the Freon package access door.

(2) Remove nuts, washers, and bolts from connecting flange on forward end of duct section which passes through centerline bulkhead. This duct runs forward from the check valve and bends approximately 45 degrees toward the centerline bulkhead.

(3) Release mounting clamp at aft edge of heat exchanger access door which secures duct section to mounting bracket.

(4) Remove duct section and attached check valve through heat exchanger access door.

(5) Separate check valve from duct by removing nuts, washers, and bolts from the connecting flange.

D. Install Cabin Recirculation Air Check Valve.

(1) Prior to installation in airplane, connect check valve to aft end of duct section which bends approximately 45 degrees toward the centerline bulkhead. Install bolts, washers, and nuts to secure connecting flanges.

(2) Determine that connecting hose and clamps are in position to connect aft end of check valve to crossover duct. Position assembled duct and check valve in airplane so that hose connection aft of check valve and flange connection on forward end of duct are mated to their connections.

(3) Position hose and install clamp to secure aft end of check valve to crossover duct.

NOTE: If Freon package is removed, this step can be accomplished much easier by reaching through the Freon package access door.

(4) Install clamp which secures duct section to mounting bracket near aft edge of heat exchanger access door.

(5) With gasket in place, install bolts, washers, and nuts in connecting flanges at forward end of duct which bends approximately 45 degrees. (Connecting flange is near and parallel to the centerline bulkhead.)

(6) Operate recirculation fan and check for normal airflow indication.

E. Remove Flight Compartment Recirculation Air Check Valve.

(1) Release hose clamp at upper rear connection of branched duct. (Branched duct is next to centerline bulkhead; forward end of duct connects to recirculation fan outlet.)

(2) Release hose clamp at aft end of the flight compartment recirculation air check valve. (Check valve is located about two feet aft of hose clamp released in step (1).)

(3) Release clamp which secures duct section to mounting bracket near forward end of check valve.

(4) Remove short straight duct section with check valve attached.

(5) Separate check valve from duct by removing nuts, washers, and bolts from connecting flange.

F. Install Flight Compartment Recirculation Air Check Valve.

(1) Prior to installation in airplane, attach check valve to short straight duct section by installing bolts, washers, and nuts in connecting flanges.

(2) Position assembled valve and duct section in airplane with check valve aft. Forward end of duct section connects to upper rear connection on branched duct. (Near centerline bulkhead.)

(3) Install hose and clamp on forward end of duct section and at aft end of check valve.

(4) Install clamp to secure duct section to mounting bracket just forward of check valve.

(5) Close heat exchanger access door.

(6) Operate recirculation fan and check for normal air flow indication.

2. For additional information on recirculation air check valve maintenance practices, refer to 21-3-13, Maintenance Practices.

CONDENSER FAN - MAINTENANCE PRACTICES

1. Removal/Installation Condenser Fan

NOTE: The condenser fan and the condenser ground cooling air shutoff valve are removed from the airplane as an assembled unit. After removal, the two components are separated (refer to 21-3-8, Maintenance Practices).

2. Adjustment/Test Condenser Fan

A. Operate Freon package for approximately 15 minutes; there shall be no sign of overheating in condenser fan.

CAUTION: CHECK DIRECTION OF ROTATION OF CONDENSER FAN BY FEELING FOR AIR DISCHARGED AFT INTO MAIN LANDING GEAR WHEEL WELL. IF ROTATION IS WRONG, REVERSE ANY TWO POWER LEADS. DO NOT CHANGE GROUND LEAD T_o.

3. Inspection/Check Condenser Fan

A. Check condenser fan for the following:

(1) Check mounting flanges for cracks or distortion.

(2) Check fan housing nuts and bolts for security.

(3) Check paint for damage and inspect any exposed metal for corrosion.

4. Cleaning/Painting Condenser Fan

A. Clean condenser fan. Clean surfaces with soft, lintless cloth moistened with solvent, Specification AMS 3160A, to remove oil or grease deposits.

B. Paint condenser fan.

(1) Touch up worn or damaged painted surfaces when damage does not affect a large area.

(2) Remove corrosion with steel wool, and finish with fine crocus cloth.

(3) Apply two primer coats of zinc chromate, Specification AMS 3110C; allow each coat to air-dry 30 minutes between applications.

(4) Apply two coats of enamel, Specification AMS 3120B; allow each coat to air-dry four hours between applications.

CONDENSER GROUND COOLING AIR SHUTOFF VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Condenser Ground Cooling Air Shutoff Valve (see Figure 201)

A. Equipment Required - None.

B. Preparation.

(1) Remove Freon package for access to valve (refer to 21-3-1, Maintenance Practices).

(2) Open CONDENSER GROUND COOLING circuit breaker (cabin or flight deck as required).

(3) Remove three FREON COND CABIN, or FREON COND FLT DECK fuses from ac power distribution panel.

WARNING: DO NOT OPEN AC POWER DISTRIBUTION PANEL WHEN BATTERY IS ON, ENGINES ARE RUNNING, OR WHEN EXTERNAL POWER IS CONNECTED TO AIRPLANE.

C. Remove Condenser Ground Cooling Air Shutoff Valve.

(1) Remove clamps securing branched duct to shutoff valve and modulating valve at aft edge of Freon package access door.

(2) Reaching aft from access door, disconnect electrical connector from shutoff valve actuator and power leads from condenser fan motor.

CAUTION: TAG MOTOR LEADS FOR IDENTIFICATION UPON INSTALLATION.

(3) Remove clamp securing fan to wheel well discharge duct.

(4) Remove nuts and bolts securing unit mounting frame to airplane mounting frame.

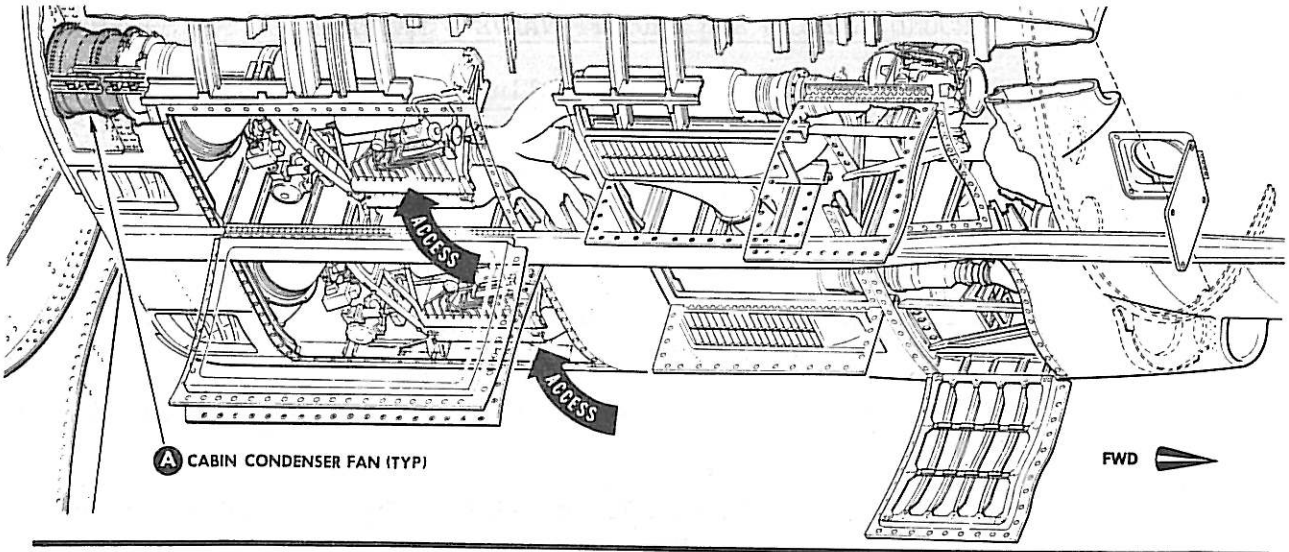
NOTE: The condenser ground cooling air shutoff valve and condenser fan are installed in the airplane as an assembled unit.

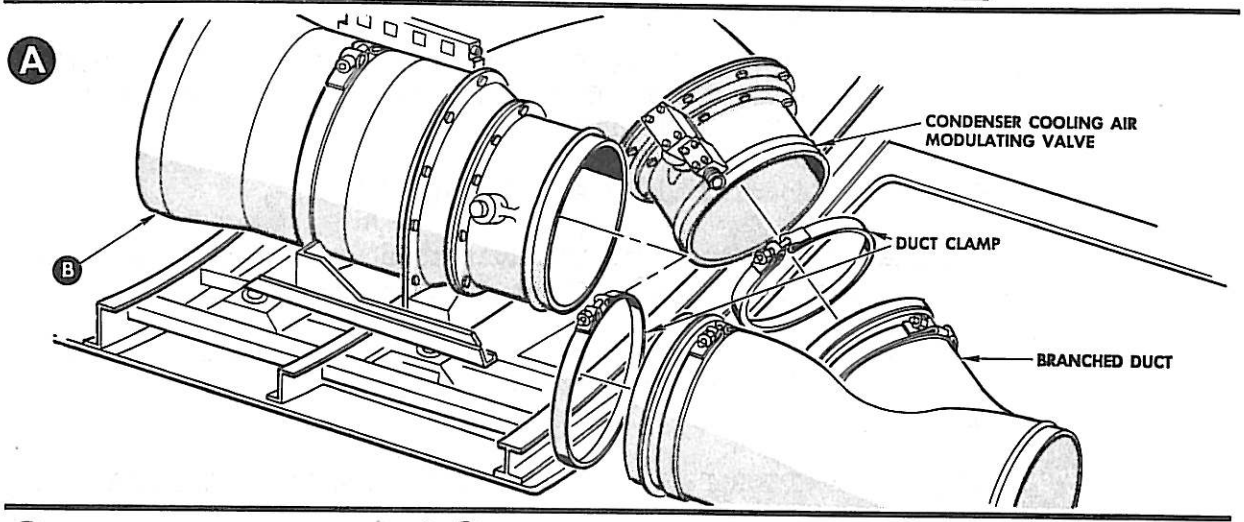
(5) Slide fan and valve unit forward, disconnect ground strap, and remove assembly through Freon package access door.

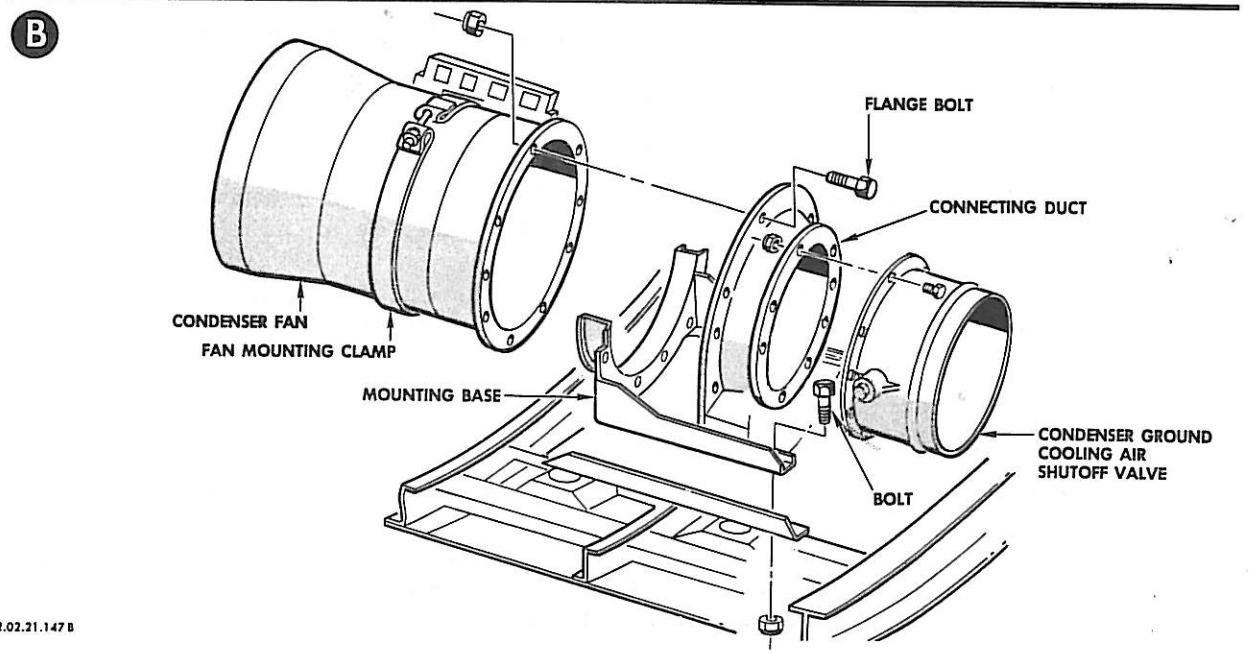
(6) Separate fan from valve by removing bolts from connecting duct flange.

D. Install Condenser Ground Cooling Air Shutoff Valve.

(1) Connect valve to fan and mounting frame connecting duct by installing bolts and nuts in connecting flanges; valve actuator shall be 120 degrees clockwise from top when viewing valve end of unit.







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Condenser Ground Cooling Air Shutoff Valve and Condenser Fan Installation
Figure 201

(2) Place assembled unit on airplane mounting bracket, connect grounding strap, and slide aft to engage locating pins. Fan must align with wheel well discharge duct at aft end.

(3) Install two bolts and nuts to secure forward end of assembled unit.

(4) Install and tighten clamp to secure fan to discharge duct.

(5) Connect power leads to fan motor.

CAUTION: CHECK IDENTIFICATION TAGS FOR PROPER TERMINAL CONNECTIONS.

(6) Connect electrical connector to valve actuator.

(7) Position branched condenser discharge duct and secure to shutoff and modulating valves with hose and clamps.

(8) Install Freon package (refer to 21-3-1, Maintenance Practices).

(9) Install three FREON COND CABIN or FREON COND FLT DECK fuses in ac power distribution panel.

CAUTION: DO NOT OPEN AC POWER DISTRIBUTION PANEL WITH BATTERY ON, ENGINES RUNNING, OR WITH EXTERNAL POWER CONNECTED TO AIRPLANE.

(10) Close CONDENSER GROUND COOLING circuit breaker.

(11) Operate air-conditioning system and perform functional check (refer to 21-0, Maintenance Practices).

2. Cleaning/Painting

A. Clean valve bore and exterior surfaces as follows:

(1) Use soft lintless cloth moistened with solvent, Specification AMS 3160A, to wipe off dirt and grease deposits.

CAUTION: DO NOT IMMERSE VALVE IN CLEANER.

(2) Remove corrosion with fine crocus cloth.

B. Touch up paint damage when total damage does not exceed five percent of total painted area. Use zinc chromate, Specification AMS 3110C, and black enamel, Specification AMS 3120B; allow paint to dry at least four hours at room temperature.

3. Approved Repair

A. Repair valve by replacing actuator when required.

(1) Remove actuator by removing retaining nuts and washer.

(2) Hold new actuator in position over shaft (with receptacle toward valve upstream) and rotate valve disc until shaft splines line up.

CAUTION: DO NOT ROTATE VALVE DISC WITH ACTUATOR INSTALLED.

(3) Connect actuator to valve and secure with retaining washers and nuts.

(4) Check valve performance (refer to 21-0, Maintenance Practices).

B. Additional valve repair is limited to corrosion removal and paint retouching.

CONDENSER COOLING AIR MODULATING VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Condenser Cooling Air Modulating Valve (see Figure 201)

A. Equipment Required - None.

B. Preparation.

(1) Open Freon package access door (cabin or flight deck).

(2) Open CONDENSER GROUND COOLING circuit breaker (cabin or flight compartment as required).

(3) Remove Freon package (refer to 21-3-1, Maintenance Practices).

C. Remove Condenser Cooling Air Modulating Valve.

(1) Remove two clamps securing branched duct to shutoff valve and modulating valve at aft edge of Freon package access door, and remove duct.

(2) Disconnect electrical connector from valve actuator. (Cap connector and receptacle. Tag harness for installation.)

(3) Remove bolts from connecting flange at aft end of valve.

(4) Remove valve through Freon package access door.

D. Install Condenser Cooling Air Modulating Valve.

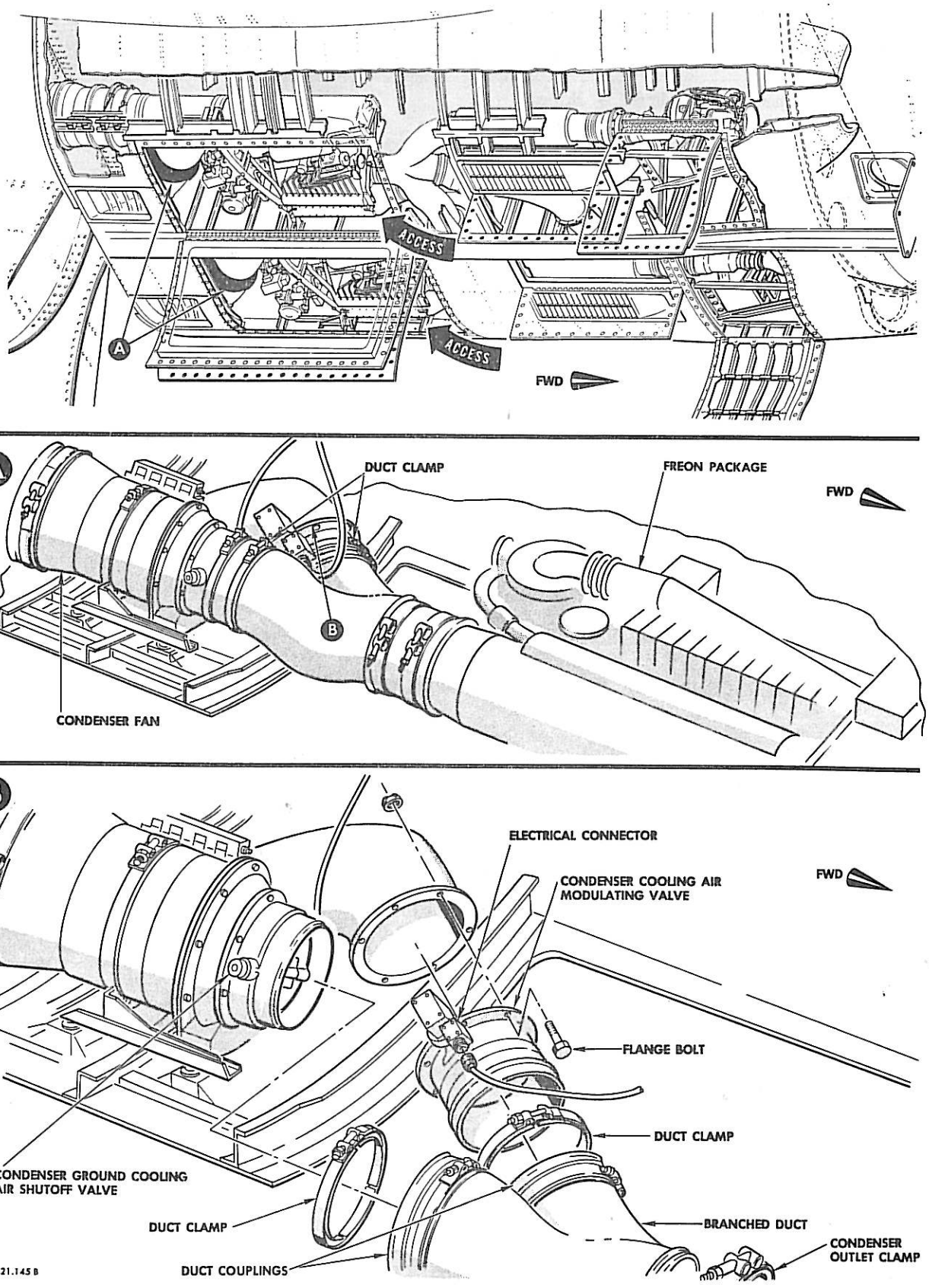
NOTE: Freon package must be removed for access.

(1) Position valve in airplane with connecting flange aft to mate with discharge duct leading to lower surface of airplane. The valve actuator shall be 60 degrees from top toward condenser fan.

(2) Install bolts and nuts in connecting flanges to secure valve to discharge duct; connect bonding jumper from branched duct to valve flange with one of the connecting bolts.

(3) Connect electrical connector to valve actuator.

(4) Position branched duct to connect with condenser outlet, shutoff valve and modulating valve. Secure in position with three hose clamps.



Condenser Cooling Air Modulating Valve Installation
Figure 201

(5) Install Freon package (refer to 21-3-1, Maintenance Practices).

(6) Close CONDENSER GROUND COOLING circuit breaker.

(7) Perform operational check of air conditioning system (refer to 21-0, Maintenance Practices).

2. Cleaning/Painting

A. Clean valve bore and exterior surfaces as follows:

(1) Use a soft lintless cloth moistened with solvent, Specification AMS 3160A to wipe off dirt and grease deposits.

CAUTION: DO NOT IMMERSE VALVE IN CLEANER.

(2) Remove corrosion using a fine crocus cloth.

B. Touch up paint damage when total damage does not exceed 5 percent of total painted area. Use zinc chromate, Specification AMS 3110C, and black enamel, Specification AMS 3120B and allow paint to dry to least 4 hours at room temperature.

3. Approved Repair

A. Repair valve by replacing actuator when required (see Figure 201).

(1) Remove actuator by removing retaining nuts and washers.

(2) Hold new actuator in position over shaft (with receptacle toward valve upstream) and rotate valve disc until shaft splines line up with actuator splines.

CAUTION: DO NOT ROTATE VALVE DISC WHEN ACTUATOR IS INSTALLED.

(3) Assemble actuator to valve, securing with retaining nuts and washers.

(4) Check valve performance.

CONDENSER COOLING AIR PRESSURE SWITCH - MAINTENANCE PRACTICES

1. Removal/Installation Condenser Cooling Air Pressure Switch

   A. Equipment Required - None.

   B. Preparation.

      (1) Open FLT DECK FREON SYS CONT circuit breaker.

      (2) Gain access to switch through flight deck Freon package access door.

      NOTE: Switch is mounted on airplane structure near the aft outboard side of compartment immediately inside access door opening.

   C. Remove Condenser Cooling Air Pressure Switch.

      (1) Loosen coupling nut and disconnect ambient air sensing port tubing from elbow fitting on outboard side of pressure switch.

      (2) Disconnect electrical harness from receptacle on inboard side of pressure switch.

      (3) Remove two nuts and remove bolts securing pressure switch to airplane structure; remove switch.

   D. Install Condenser Cooling Air Pressure Switch.

      (1) Position pressure switch on airplane structure with holes in switch bracket in line with mounting holes in structure; install and secure mounting bolts.

      (2) Connect tubing to elbow fitting on outboard side of switch; tighten coupling nut.

      (3) Connect electrical harness to receptacle on inboard side of switch.

      (4) Close FLT DECK FREON SYS CONT circuit breaker.

CONDITIONED AIR EMERGENCY SHUTOFF VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Conditioned Air Emergency Shutoff Valve

   A. Equipment Required - None.

   B. Preparation - Open CABIN & FLT DECK AIR SOV circuit breakers.

   C. Remove Cabin Conditioned Air Emergency Shutoff Valve.

      (1) Open cabin heat exchanger access door (right side).

      (2) Disconnect electrical connector from conditioned air emergency shutoff valve. (Cap connector and receptacle. Tag harness for installation.)

      (3) Remove forward and aft hose clamps to release valve.

      (4) Remove valve through heat exchanger access door.

   D. Install Cabin Conditioned Air Emergency Shutoff Valve.

      (1) Position shutoff valve between duct openings with electric actuator at 2 o'clock position when viewed from aft end.

      (2) Position hoses and install hose clamps to secure valve in position.

      (3) Connect electrical connector to valve actuator.

      (4) Close heat exchanger access door.

      (5) Close CABIN & FLT DECK AIR SOV circuit breakers.

      (6) Perform operational check of system (refer to 21-0, Maintenance Practices).

   E. Remove Flight Compartment Conditioned Air Emergency Shutoff Valve.

      (1) Remove flight compartment (left side) turbocompressor package (refer to 21-1-1, Maintenance Practices).

      (2) Disconnect electrical connector from conditioned air emergency shutoff valve. Looking aft from turbocompressor access door, valve is located near top outboard side of compartment just forward of electric heater. (Cap connector and receptacle. Tag harness for installation.)

      (3) Remove forward and aft hose clamps to release valve.

      (4) Move valve outboard and forward for removal through turbocompressor access door.

F. Install Flight Compartment Conditioned Air Emergency Shutoff Valve.

NOTE: Flight compartment turbocompressor package must be removed for installation of flight compartment conditioned air emergency shutoff valve (refer to 21-1-1, Maintenance Practices).

(1) Move valve outboard from turbocompressor door and then aft through the space outboard of air conditioning components to reach mounting position. Position valve between duct openings with electric actuator at 5 o'clock position when viewed from aft end.

(2) Position hoses and install forward and aft hose clamps to secure valve in position.

(3) Connect electrical connector to the valve actuator.

(4) Close CABIN & FLT DECK AIR SOV circuit breakers.

NOTE: An operational check of the valve may be performed prior to installing turbocompressor package. Check operation by using the recirculation fan and the FLT DECK OFF-BOTH ON-CABIN OFF switch (refer to 21-0, Maintenance Practices).

(5) Install flight compartment turbocompressor package (refer to 21-1-1, Maintenance Practices).

(6) Perform operational check of system if not done prior to installation of turbocompressor package.

2. Inspection/Check

A. Examine valve exterior as follows:

(1) Check actuator receptacle for damaged or worn threads; check pins for looseness or bending.

(2) Examine inlet and outlet connecting beads for cracks, scratches, grooves or other damage that might cause leakage.

(3) Check actuator mounting bolts and shaft end plug for tightness.

(4) Examine all surfaces for damage or wear.

(a) Check painted areas for damaged or worn surface treatment.

(b) Check any exposed metal for corrosion.

(c) Check actuator cover for dents which might interfere with operation.

3. Cleaning/Painting

A. Clean valve bore and exterior surface as follows:

(1) Use a soft lintless cloth moistened with solvent, Specification AMS 3160A to wipe off dirt and grease deposits.

CAUTION: DO NOT IMMERSE VALVE IN CLEANER.

(2) Remove corrosion using fine crocus cloth.

B. Touch up paint damage when total damage does not exceed 5 percent of total painted area. Use zinc chromate primer, Specification AMS 3110C, and black enamel, Specification AMS 3120B; allow paint to dry at least 4 hours at room temperature.

4. Approved Repair

A. Repair valve by replacing actuator when required (see Figure 201).

(1) Remove valve from airplane (refer to Removal/Installation). Open CABIN & FLT DECK AIR SOV circuit breakers.

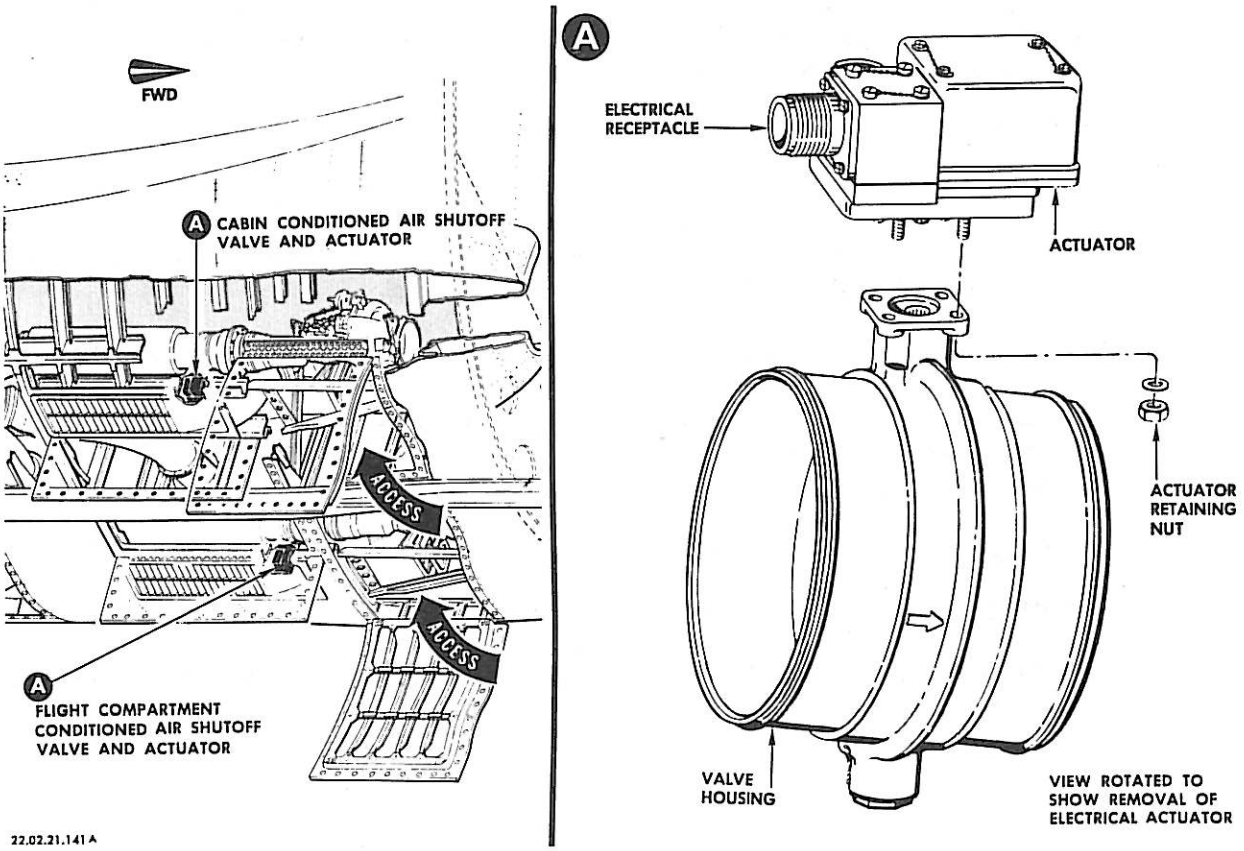
(2) Remove actuator from valve by removing retaining nuts and washers.

(3) Hold new actuator in position with receptacle toward valve upstream and rotate valve disc until shaft splines line up with actuator splines.

CAUTION: DO NOT ROTATE VALVE DISC WHEN ACTUATOR IS INSTALLED.

(4) Slide actuator on shaft and secure with washers and nuts.

(5) Install conditioned air emergency shutoff valve (refer to Removal/Installation).



Conditioned Air Emergency and Crossover
Shutoff Valve Actuator Installation
Figure 201

CROSSOVER SHUTOFF VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Crossover Shutoff Valve

   A. Equipment Required - None.

   B. Preparation.

      (1) Open EVAP AIR SHUTOFF VALVE circuit breaker.

      (2) Remove flight compartment (LH) Freon package (refer to 21-3-1, Maintenance Practices).

   C. Remove Crossover Shutoff Valve.

      (1) Disconnect electrical connector from receptacle on valve actuator. Looking forward from Freon package access door, the valve is just forward of door opening and next to centerline bulkhead. (Cap connector and receptacle. Tag harness for installation.)

      (2) Remove nut, bolt and clamp and disconnect bonding jumper from valve actuator shaft housing.

      (3) Remove left and right hose clamps nearest valve.

      (4) Remove valve.

   D. Install Crossover Shutoff Valve.

      NOTE: Flight compartment Freon package must be removed for installation of crossover shutoff valve.

      (1) Position valve between duct openings just forward of access door and near centerline bulkhead. Actuator shall be aft, and electrical receptacle shall point outboard.

      (2) Position hoses and install hose clamps on left and right sides of valve.

      (3) Connect electrical connector to receptacle on valve actuator.

      (4) Connect bonding jumper to valve actuator shaft housing and secure with clamp, bolt and nut.

      (5) Install flight compartment Freon package (refer to 21-3-1, Maintenance Practices).

      (6) Close EVAP AIR SHUTOFF VALVE circuit breaker.

(7) Perform system operational check (refer to 21-0, Maintenance Practices).

2. For additional information on crossover shutoff valve maintenance practices, refer to 21-3-11, Maintenance Practices.

CONDITIONED AIR CHECK VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Conditioned Air Check Valve

   A. Equipment Required - None.

   B. Preparation.

      (1) Open forward cargo compartment door.

      (2) Open zippered lining at aft bulkhead of cargo compartment.

      NOTE: Cabin and flight compartment conditioned air check valves are located near floor of compartment against aft bulkhead. When looking aft, the cabin valve is to the left, and the flight compartment valve is to the right.

   C. Remove Conditioned Air Check Valve (Cabin or Flight Compartment).

      (1) Release aft end of check valve by removing nuts, washers, and bolts from connecting flanges.

      (2) Release forward end of check valve by removing hose clamp.

      (3) Remove check valve and gasket.

   D. Install Conditioned Air Check Valve (Cabin or Flight Compartment).

      (1) With gasket in place, position connecting flange on check valve against connecting flange on conditioned air duct.

      NOTE: Bolt holes in connecting flanges are not uniformly spaced. Rotate check valve until all mating holes are aligned.

      (2) Install bolts, washers, and nuts to secure valve to duct.

      (3) Install hose and clamp to secure forward end of valve to duct.

      (4) Close zippered lining at aft bulkhead of cargo compartment, and close cargo compartment door.

      (5) Refer to Adjustment/Test for operational check.

2. Adjustment/Test Conditioned Air Check Valve

   A. Equipment Required and Preparation.

      (1) Test of the conditioned air check valves requires operation of the air conditioning and pressurization system (refer to 21-0, Maintenance Practices).

(2) Place Freon MASTER ON-OFF switch in OFF position. (Freon compressors not required for this test.)

(3) Place FREON COMPRESSOR FLT DECK OFF-BOTH ON-CABIN OFF switch in BOTH ON position. (Required to close crossover shutoff valve.)

B. Test Cabin Conditioned Air Check Valve.

(1) Place cabin turbocompressor AUTO-OFF-MAN ON switch in MAN ON position. A normal cabin air flow indicates that the cabin conditioned air check valve is open.

(2) Place cabin turbocompressor AUTO-OFF-MAN ON switch in OFF position and flight deck turbocompressor switch in MAN ON position; there shall be no cabin air flow indicated.

NOTE: If cabin air flow is indicated, there are two possible sources: reverse flow from a conditioned air check valve stuck open, or the crossover shutoff valve is not fully closed. Check visual indicator on crossover shutoff valve. If valve is closed, the conditioned air check valve must be stuck open. If crossover shutoff valve is not fully closed, determine cause and repair as necessary.

(3) After completion of test, shut down system (refer to 21-0, Maintenance Practices).

C. Test Flight Compartment Conditioned Air Check Valve.

(1) Place flight compartment turbocompressor AUTO-OFF-MAN ON switch in MAN ON position. A normal flight deck air flow indicates that the flight compartment conditioned air check valve is open.

(2) Place flight compartment turbocompressor AUTO-OFF-MAN ON switch in OFF position and cabin turbocompressor switch in MAN ON position. There shall be no flight compartment air flow indicated.

NOTE: If flight compartment air flow is indicated, there are two possible sources: reverse flow from a conditioned air check valve stuck open, or the crossover shutoff valve is not fully closed. Check visual indicator on crossover shutoff valve. If valve is closed, the conditioned air check valve must be stuck open. If crossover shutoff valve is not fully closed, determine cause and repair as necessary.

(3) After completion of test, shut down system (refer to 21-0, Maintenance Practices).

3. Inspection/Check

A. Check exterior surfaces of valve as follows:

(1) Examine painted areas for damage to surface treatment.

(2) Check screws that secure flange to valve body for tightness.

(3) Check flange and bead on valve inlet and outlet for cracks, dents, scratches or other damage that might impair sealing.

(4) Check all exposed metal for corrosion.

B. Check valve interior walls and flappers as follows:

(1) Manually actuate each flapper checking for binding or excessive load.

(2) Check internal surfaces for corrosion, dents, cuts, and obstructions that might impair air flow through valve or prevent sealing of the flappers against their seats.

4. Cleaning/Painting

A. Clean valve using AMS 3160A solvent; rise and dry thoroughly.

B. Retouch damaged paint with AMS 3120B black enamel. Allow paint to dry thoroughly (at least 4 hours) at room temperature.

5. Approved Repair

A. Replace valve when damaged, worn, or malfunctioning. Remove corrosion with crocus cloth.

RAM AIR SHUTOFF VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Ram Air Shutoff Valve

A. Equipment Required - None.

B. Preparation.

(1) Remove turbocompressor package (cabin or flight compartment). (Refer to 21-1-1, Maintenance Practices.)

(2) Open RAM AIR SHUTOFF VALVE circuit breaker.

C. Remove Ram Air Shutoff Valve.

(1) Disconnect electrical connector from ram air shutoff valve actuator. (Cap connector and receptacle. Tag harness for installation.)

(2) Remove mounting bolts, nuts, and washers near inlet end which secure valve to mounting bracket.

(3) Remove flange mounting bolts, nuts, and washers which connect valve to duct.

(4) Remove valve and gasket.

D. Install Ram Air Shutoff Valve.

NOTE: Turbocompressor package must be removed for installation of ram air shutoff valve.

(1) Position ram air shutoff valve with gasket against duct opening.

NOTE: Name plate of cabin valve shall be on the bottom. Name plate of flight compartment valve shall be at 11 o'clock position looking outboard.

(2) Install bolts, washers, and nuts to secure valve to duct.

(3) Install bolts, washers and nuts to secure inlet end of valve to mounting bracket.

(4) Connect electrical connector to valve actuator.

(5) Close RAM AIR SHUTOFF VALVE circuit breaker.

NOTE: Operational check of ram air shutoff valve may be performed prior to installation of turbocompressor package. Refer to 21-0, AIR CONDITIONING AND PRESSURIZATION.

(6) Install turbocompressor package (refer to 21-1-1, Maintenance Practices).

(7) Perform operational check of system if ram air shutoff valve was not checked prior to installation of turbocompressor package.

2. Inspection/Check

A. Check Shaft and Flapper Movement of Valve.

(1) With actuator cycled to open position, manually actuate flapper and shaft to open position and note any binding or restriction to movement.

3. Cleaning/Painting

A. Clean Ram Air Shutoff Valve.

(1) Remove external grease and oil deposits with solvent Specification AMS 3160A applied with a soft lintless cloth. Dry thoroughly.

NOTE: Do not allow solvent to enter electrical actuator.

B. Paint Shutoff Valve.

(1) Touch up worn or damaged paint when damage does not effect a large area.

(a) Remove corrosion with steel wool or fine crocus cloth.

(b) Mask off nameplate and connecting flanges.

(2) Apply priming coat of zinc chromate, Specification AMS 3110C to obtain a thick greenish yellow surface.

(3) Allow primer to dry 30 minutes at room temperature.

(4) Apply two coats of glyceryl phthalate black enamel, Specification AMS 3120B.

(5) Allow paint to dry four hours between coats before installation.

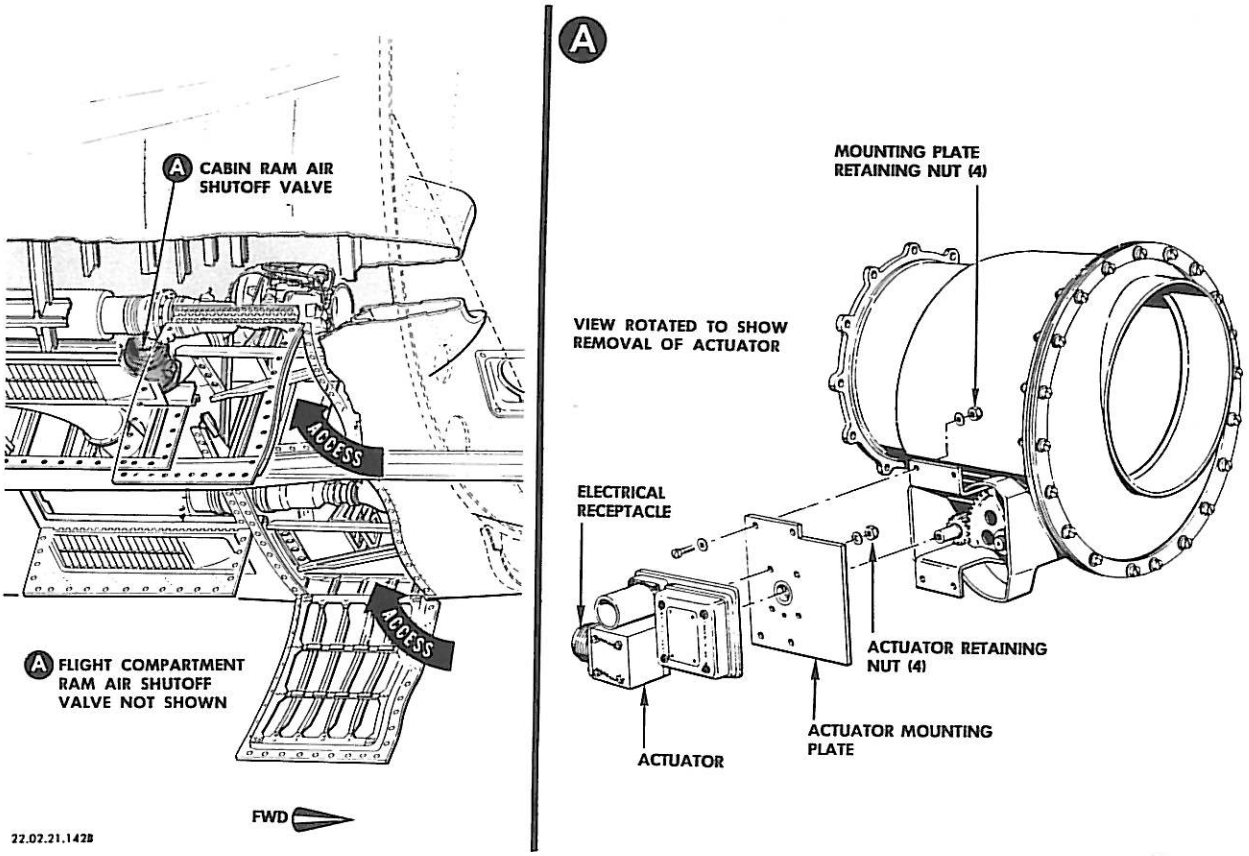
4. Approved Repairs

A. Remove Malfunctioning Actuator (see Figure 201).

(1) Open RAM AIR SHUTOFF VALVE circuit breaker.

(2) Disconnect electrical connector from valve actuator.

(3) Remove four mounting plate retaining nuts, bolts, and washers.


A CABIN RAM AIR SHUTOFF VALVE
ACCESS
ACCESS
A FLIGHT COMPARTMENT RAM AIR SHUTOFF VALVE NOT SHOWN
FWD
22.02.21.142B
A
MOUNTING PLATE RETAINING NUT (4)
VIEW ROTATED TO SHOW REMOVAL OF ACTUATOR
ELECTRICAL RECEPTACLE
ACTUATOR RETAINING NUT (4)
ACTUATOR MOUNTING PLATE
ACTUATOR

(4) Separate actuator and mounting plate from valve.

(5) Remove four actuator retaining nuts and washers.

(6) Separate actuator from mounting plate.

B. Install Actuator (see Figure 201).

(1) Position actuator on mounting plate so that actuator alignment pin fits into hold provided on mounting plate.

(2) Install four washers and nuts to secure actuator to mounting plate.

(3) Position actuator and mounting plate on valve with electrical connector pointing toward duct end of valve housing.

(4) Install four bolts, washers, and nuts to secure mounting plate to valve housing.

(5) Connect electrical connector to valve actuator.

(6) Close RAM AIR SHUTOFF VALVE circuit breaker.

(7) Check operation of valve.

C. Remove dents or distortion in metal housing with rawhide hammer.

TURBOCOMPRESSOR CHECK VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Turbocompressor Check Valve

   A. Equipment Required - None.

   B. Preparation - Remove cabin or flight compartment turbocompressor package as required (refer to 21-1-1, Maintenance Practices).

   C. Remove Turbocompressor Check Valve.

      (1) Remove hose clamp at aft end of turbocompressor check valve. (Connects to forward end of heat exchanger.) (Tag for installation.)

      (2) Remove check valve from airplane with short duct section attached.

      (3) Separate check valve from duct by removing nuts, washers, and bolts from connecting flanges.

   D. Install Turbocompressor Check Valve.

      NOTE: Turbocompressor package must be removed for access.

      (1) Prior to installation in airplane, connect check valve to short, straight duct section which will connect it to turbocompressor venturi duct. Install bolts, washers, and nuts to secure connecting flanges.

      (2) Position assembled duct and check valve so that aft end of check valve connects with heat exchanger inlet.

      (3) Position hose and install clamp to secure connection between check valve and heat exchanger.

      (4) Install turbocompressor package (refer to 21-1-1, Maintenance Practices).

      (5) Operate turbocompressor and check for normal airflow indication (refer to 21-0, Maintenance Practices).

   E. For additional information on turbocompressor check valve maintenance practices, refer to 21-3-13, Maintenance Practices.

FLIGHT DECK ELECTRIC HEATER - MAINTENANCE PRACTICES

1. Removal/Installation Flight Deck Electric Heater (see Figure 201)

A. Equipment Required - None.

B. Preparation.

(1) Open GROUND HEATER CONT circuit breaker.

(2) Remove three FREON COMPR AIR COND HTRS fuses from No. 4 NON ESS AC BUS. (Located on ac power distribution panel below flight engineer's control panel.)

WARNING: DO NOT OPEN AC POWER DISTRIBUTION PANEL WHEN BATTERY IS ON, ENGINES ARE RUNNING, OR WHEN EXTERNAL POWER IS CONNECTED TO AIRPLANE.

(3) Remove flight compartment (LH) heat exchanger (refer to 21-3-2, Maintenance Practices).

C. Remove Flight Deck Electric Heater.

(1) Release snap fasteners and remove insulating cover from electric heater.

(2) Disconnect electric connector from thermal switch receptacle near front of heater.

(3) Remove terminal cover plate by removing six retaining screws.

(4) Release power leads from 21 terminals, and single lead from ground terminal. (Replace nuts on terminals and identify wiring for installation.)

(5) Replace terminal cover and secure with six retaining screws.

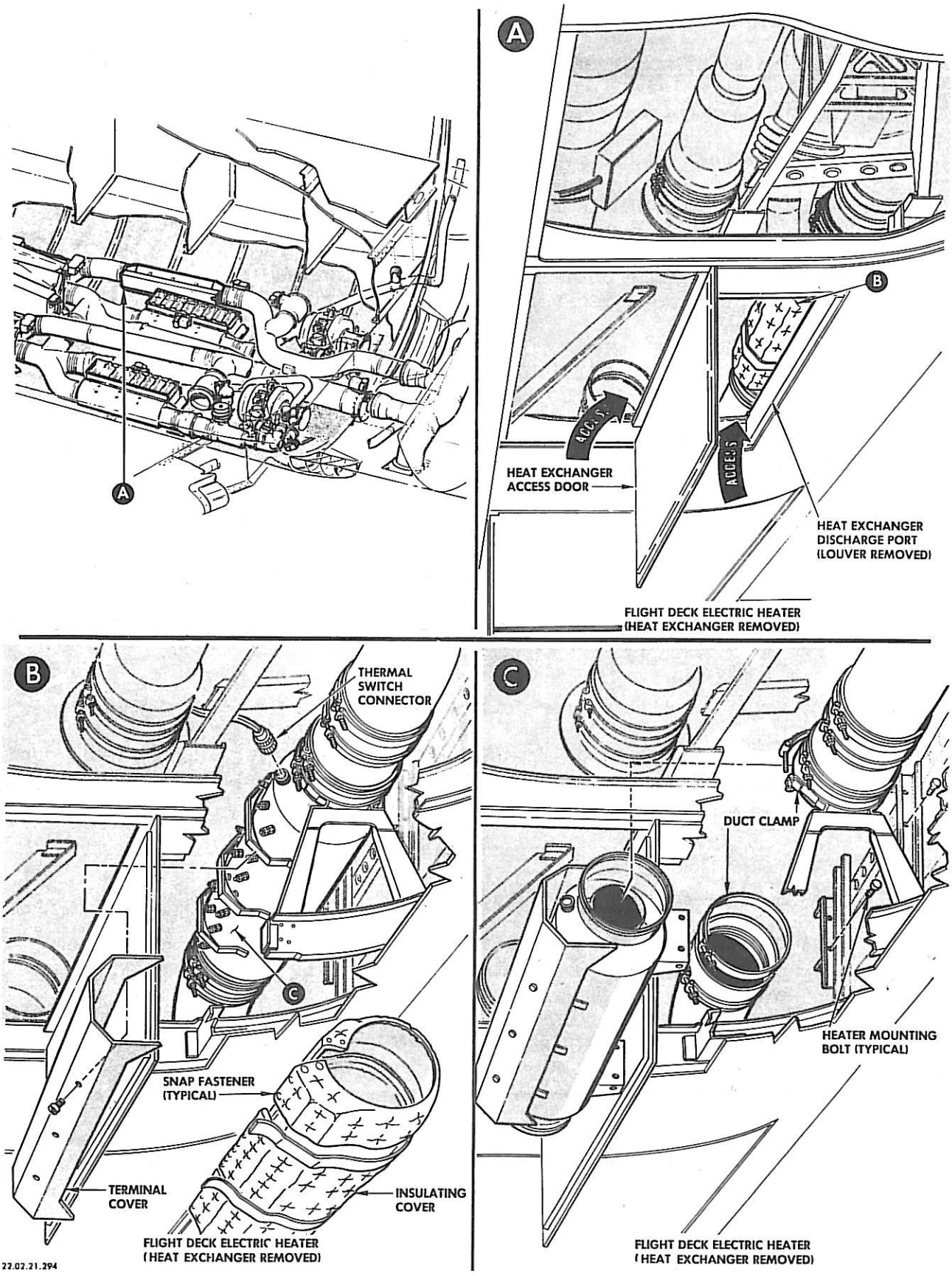
(6) Release forward and aft duct clamps from heater.

(7) Remove bolts which secure heater mounting brackets to airplane structure. (Support heater while removing last bolt from each bracket.)

(8) Remove electric heater through heat exchanger access door.

D. Install Flight Deck Electric Heater.

(1) Insert electric heater through left heat exchanger access door. Position heater between duct connections with thermal switch receptacle forward and terminal cover plate on right hand side.


A
B
HEAT EXCHANGER ACCESS DOOR
ACCESS
HEAT EXCHANGER DISCHARGE PORT (LOUVER REMOVED)
FLIGHT DECK ELECTRIC HEATER (HEAT EXCHANGER REMOVED)
B
THERMAL SWITCH CONNECTOR
C
SNAP FASTENER (TYPICAL)
TERMINAL COVER
INSULATING COVER
FLIGHT DECK ELECTRIC HEATER (HEAT EXCHANGER REMOVED)
C
DUCT CLAMP
HEATER MOUNTING BOLT (TYPICAL)
FLIGHT DECK ELECTRIC HEATER (HEAT EXCHANGER REMOVED)
22.02.21.294

NOTE: Flight compartment heat exchanger must be removed for installation of flight deck electric heater.

(2) Install bolts through heater mounting brackets and secure heater to airplane structure.

(3) Connect forward and aft duct connections to heater and secure with clamps.

(4) Remove terminal cover plate by removing six retaining screws.

(5) Connect 21 power leads to power terminals and single ground lead to ground terminal.

(6) Replace terminal cover plate and secure with six retaining screws.

(7) Connect electrical connector to thermal switch receptacle near front of heater.

(8) Install insulating cover around electric heater.

(9) Install flight compartment heat exchanger (refer to 21-3-2, Maintenance Practices).

(10) Close heat exchanger access doors.

(11) Install three FREON COMPR AIR COND HTRS fuses in No. 4 NON ESS AC BUS (ac power distribution panel below flight engineer's control panel).

WARNING: DO NOT OPEN AC POWER DISTRIBUTION PANEL WITH BATTERY ON, ENGINES RUNNING, OR WITH EXTERNAL POWER CONNECTED TO AIRPLANE.

(12) Close GROUND HEATER CONT circuit breaker.

(13) Check heater operation by operating recirculation fan and manually scheduling heating.

2. Inspection/Check Flight Deck Electric Heater

A. Check heater for the following:

(1) Examine painted surfaces for damage or wear.

(2) Check electrical receptacle threads and pins for damage or corrosion.

(3) Check inlet and outlet connections for cracks, grooves, or scratches that might cause leakage.

(4) Examine all surfaces for exposed metal, corrosion, dents or damage that might impair flow or cause leakage.

3. Cleaning/Painting Flight Deck Electric Heater

A. Clean only the exterior surfaces with a soft lintless cloth moistened with solvent, Specification AMS 3160A to remove dirt and grease deposits.

WARNING: DO NOT IMMERSE HEATER IN SOLVENT OR ALLOW CLEANER TO ENTER THE DUCT, SWITCH OR RECEPTACLE.

B. Touch up damaged paint when damage does not exceed 5 percent of the total painted area. Use black enamel, Specification AMS 3120B and allow paint to dry at least 4 hours at room temperature.

4. Approved Repair Flight Deck Electric Heater

A. Repair of the heater shall be limited to retouching paint, corrosion removal with crocus cloth or removal of slight dents using a leather mallet.

CONVAIR MODEL 30

MAINTENANCE MANUAL

TEMPORARY REVISION NO. 21-29.

Insert facing 21-3-17, Page 201, dated Nov. 15/62 (or subsequent).

The information in this temporary revision is applicable to airplanes not modified per Hamilton Standard Service Bulletin 21-18. For airplanes modified per Hamilton Standard Service Bulletin 21-18, use the instructions on Page 201.

Retain this temporary revision in your manual until applicable airplanes have been modified per noted service bulletin.

Page 201, delete entire page from your manual.

FREON COMPRESSOR MOTOR PROTECTOR - MAINTENANCE PRACTICES

1. Removal/Installation Freon Compressor Motor Protector (see Figure 201)

A. Equipment Required - None.

B. Preparation.

(1) Open FREON SYS CONT circuit breaker (cabin or flight compartment as required).

(2) Open Freon package access door (cabin or flight compartment as required).

C. Remove Freon Compressor Motor Protector.

(1) Disconnect electrical connector from receptacle on motor protector. (Tag for installation.)

(2) Remove two nuts and bolts securing motor protector to Freon package aft frame.

(3) Remove mounting bracket, mounting plate, and Freon compressor motor protector.

D. Install Freon Compressor Motor Protector.

(1) Position Freon compressor motor protector on its mounting bracket and locate on aft frame of Freon package with electrical connector toward Freon package evaporator, and protector adjustment screw pointed upward.

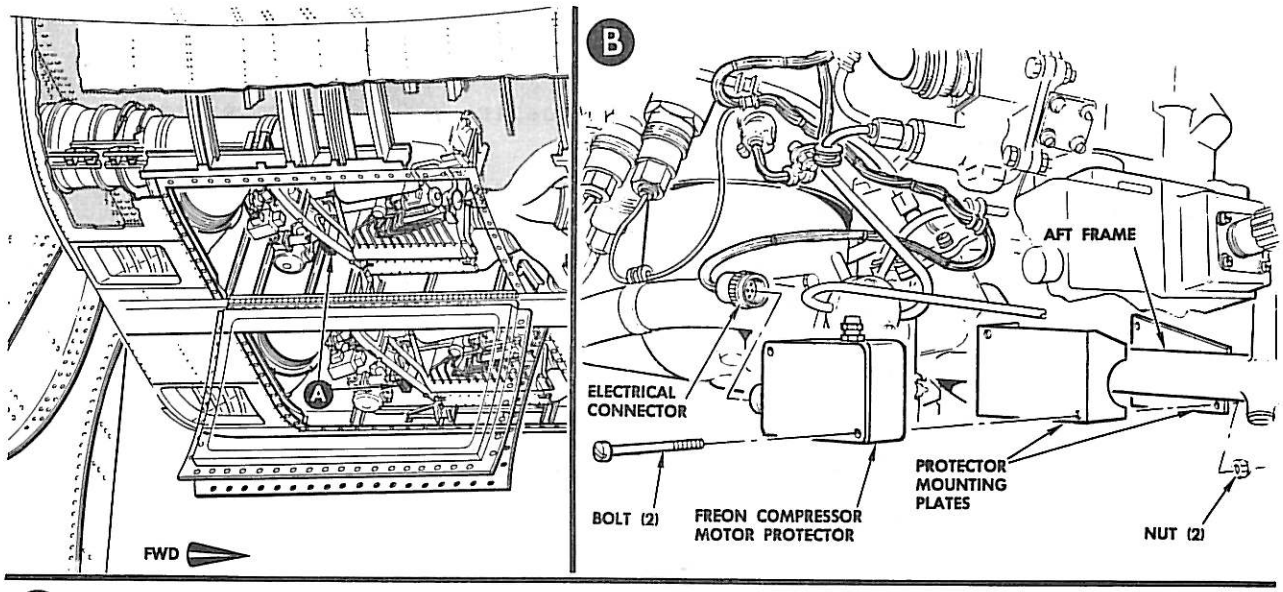
(2) Insert two mounting bolts through motor protector and mounting bracket. Assemble protector mounting plate on rear side of Freon package aft frame so that mounting bolts protrude through plate; secure bolts with nuts.

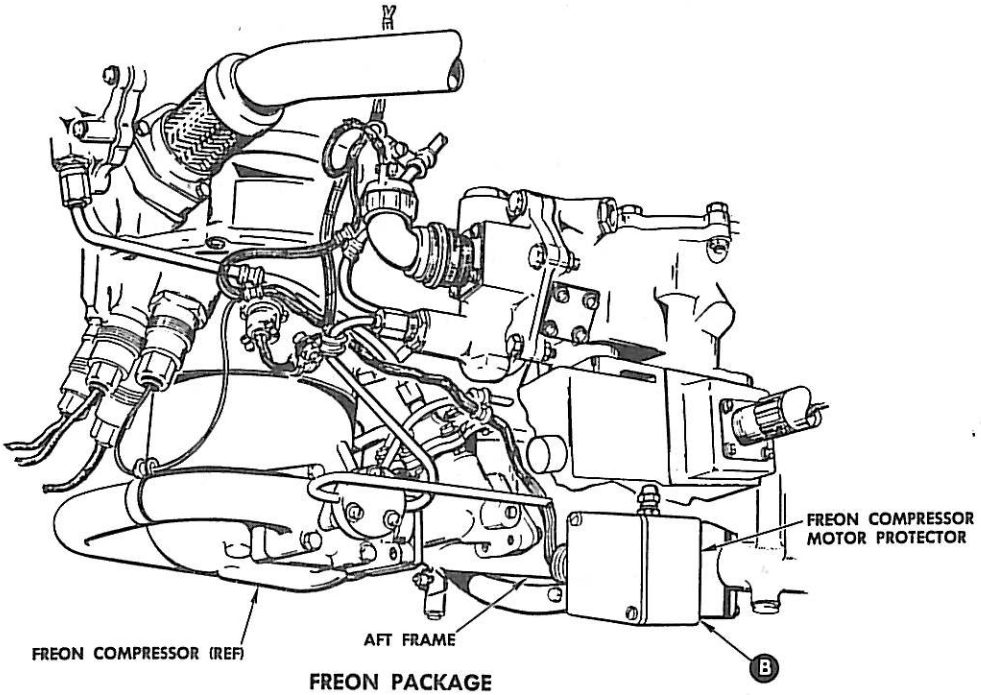
(3) Connect electrical connector to receptacle on motor protector.

(4) Close FREON SYS CONT circuit breaker (cabin or flight compartment as required).

(5) Perform operational check of air conditioning system (refer to 21-0, Maintenance Practices).

(6) Close Freon package access door.





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FREON PACKAGE

CONVAIR MODEL 30

MAINTENANCE MANUAL

TEMPORARY REVISION NO. 21-30.

Insert facing 21-3-17, Page 202, dated Nov. 15/62 (or subsequent).

The information in this temporary revision is applicable to airplanes not modified per Hamilton Standard Service Bulletin 21-18. For airplanes modified per Hamilton Standard Service Bulletin 21-18, use the information on Page 202.

Retain this temporary revision in your manual until applicable airplanes have been modified per noted service bulletin.

Page 202, delete entire page from your manual.

AIR CONDITIONING CONTROL AND INDICATION - DESCRIPTION AND OPERATION

1. General

The temperature control subsystem maintains the cabin and flight compartments at a desired temperature either through automatic operation of the system, or by manual control through actuation of the switches on the flight engineer's control panel. Separate controls for the flight and cabin compartments permit individual regulation of temperatures for either compartment. A toggle switch permits placing the operation of the system in either the manual or automatic modes. Another switch permits the manual selection of either hot or cold conditioned air. The desired temperature for the cabin and flight compartments is selected by placing their respective temperature selector in the desired position. Actual compartment temperatures, sensed by thermal resistors, are compared to the selected compartment temperature. The difference between the selected and the actual compartment temperatures causes the electronic temperature control to actuate the sequencing device. The sequencing device schedules the components of the air conditioning subsystem to provide either heating or cooling as required.

In addition to these controls, a separate group of switches and indicators is available to control and monitor the Freon refrigeration subsystem. The group consists of a Freon MASTER ON-OFF switch, a Freon compressor FLT DECK OFF-BOTH ON-CABIN OFF control switch, RECIRCULATING BLOWER AUTO-OFF-MAN switch, ram air source OPEN-CLOSE switch, malfunction lights for both Freon systems, and a cabin temperature indicator. A separate ON-OFF switch is available for the electronic compartment cooling fan. An electric schematic of the air conditioning subsystem is illustrated on Figure 1.

2. Temperature Selector

The temperature selector is a variable potentiometer located on the flight engineer's control panel. A low temperature setting (counterclockwise rotation) provides a high resistance of not more than 9,000-ohms and a high temperature setting (clockwise rotation) provides a low resistance of not more than 100-ohms. Thus, the selector signals the air conditioning system for the desired change in temperature from the ambient air temperature. A temperature selector is provided for the flight deck system, and one for the cabin system.

3. Temperature Sensors (Thermal Resistors)

The temperature sensors are negative coefficient resistors consisting of ten equal thermistors in parallel. Nominal value for the sensors is shown below.

AIR TEMPERATURE	RESISTANCE
120°F	3.2K to 4K
75°F	9.8K to 10.2K
54°F	17K to 20.5K

The temperature sensors, shown in Figure 2, are located in the conditioned air inlet ducts, one each for the cabin and flight deck, and in the air outlet ducts for each system. A thermal resistor and connector is located in each condenser ram air outlet duct and is used in the condenser minimum temperature control system.

4. Temperature Selector and Sensor Operation

When the temperature selector is positioned to increase or decrease the temperature of the conditioned air, an error signal is obtained from the compartment and duct sensors and the temperature selector which are connected in a bridge circuit. Any imbalance in the bridge causes a voltage differential to appear on the base of a transistorized amplifier. The output polarity of this bridge is then applied to the control winding of a magnetic amplifier to determine the direction and speed of rotation of the sequencing device. In order to supply sufficient gain to drive the sequencing device motor, a transistorized two stage amplifier further increases the power output of the bridge. See Figure 3, for a block diagram. A diode switching circuit permits the duct limit bridge to override the cabin bridge when the duct temperature limit of approximately 130 degrees F (54 degrees C) is attained.

5. Electronic Temperature Controller

A. Description.

The electronic temperature controller, shown on Figure 4, consists of the power supply for the temperature control subsystem, the ground/air K_1 relay, the comparison networks for the temperature input signals, the magnetic amplifier to provide control signals for control of the sequencing device, and the three transistorized amplifiers.

B. Operation.

The power supply within the electronic temperature controller supplies the necessary voltages for the operation of the various valves, potentiometers, and control circuits within the temperature control subsystem. The unit provides 22-volt and 78-volt dc, and 12.5-volt and 115-volt ac power. The ac voltages are both in phase and 180 degrees out-of-phase with the main supply voltages.

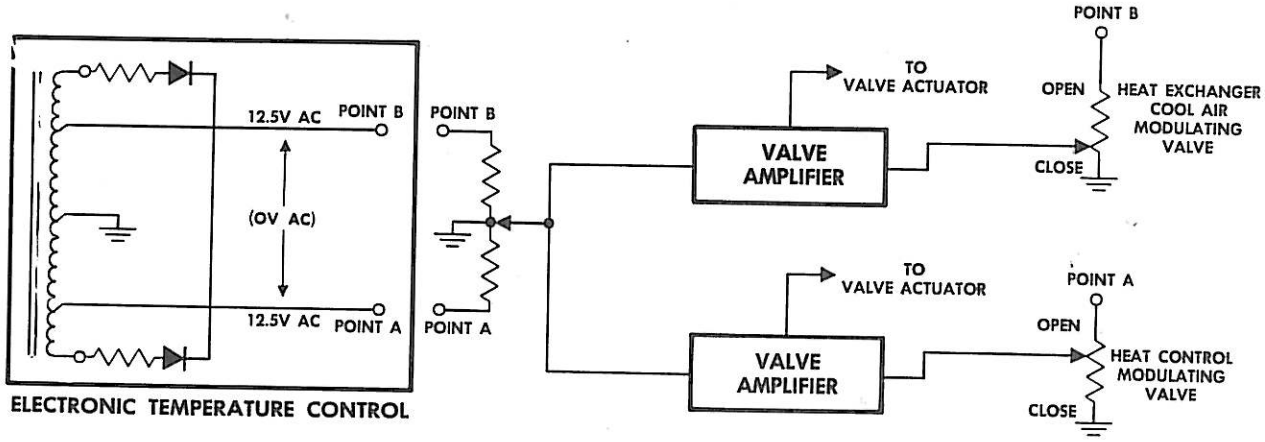
The control input to the electronic temperature controller from the temperature selector and the air temperature pickups (sensors), shown on Figure 4, presents an error signal to the signal winding of a magnetic amplifier. An imbalance in the temperature selector bridge induces a current in the magnetic amplifier which is amplified and is fed to the sequencing device motor. The sequencing device schedules heating or cooling as necessary to equalize the temperature and again produce a balanced condition in the temperature selector network. The

B. Operation.

Motor rotation is accomplished by applying ac voltage to the control and reference windings. The reference voltage, 57.5-volts ac, is capacitively coupled to one winding of the servo motor. A voltage of 0 to 57.5-volts is applied to the control winding through a magnetic amplifier and a transistorized amplifier. This control voltage either leads or lags the reference voltage by 90 degrees and determines the direction of rotation. The speed of rotation is determined by the voltage output of the amplifier. For manual operation a center-tapped transformer is used to determine the direction of rotation. When cooling is commanded a voltage with a 90 degree lag is applied to the motor and movement is in the clockwise direction; for heating a leading 90 degree voltage is applied and a counterclockwise rotation results.

C. Valve Scheduling.

The scheduling of the heat exchanger cooling air modulaing valve and the heat control modulating valve is shown on Figure 6. Two ac voltages are supplied from the power supply in the electronic temperature controller for positioning purposes. These are 12.5-volts ac between system ground and point A at any given phase, and 12.5-volts ac between system ground and point B at opposite phase from that voltage at point A. These two voltages are applied to the terminals of the positioning and feedback potentiometer to provide the differential voltage.



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